FEBRUARY 1952

THE SCIENCE TEACHER

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- Incidental Science in the Elementary Classroom

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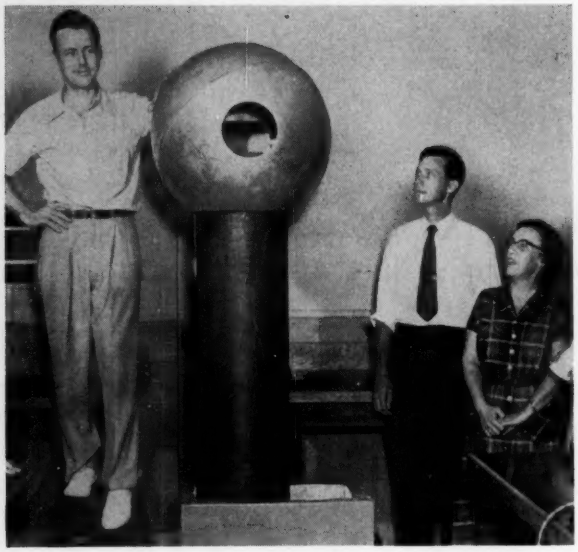

THIS MONTH'S COVER . . . pictures one of the work teams at the Science Teachers' Laboratory Conference held last summer at Duke University. This group of teachers chose to construct the Van de Graaf generator shown in the picture. A report on the conference, a preview of next summer's plans, and an announcement of a program of scholarships for high school teachers are given on pages 22 and 23.

Guided Missives

. . . One hears the cry "dues are due" once a year in many organizations. Few of them offer the friendly, honest-to-goodness helpful services NSTA does. The exchequer (she's getting her "Ph. T." at Ohio State University) says we can show our appreciation by responding to President Baker's appeal for sustaining memberships—so here is ours. Other commitments have kept me away from recent meetings at Christmas time, but I'll be with you at the Ann Arbor meeting next summer.

George M. Perdew
Worthington, Ohio

Editor's note: Mr. Perdew appeased our ignorance by explaining that the "Ph. T." means "putting hubby through."

Executive Secretary of NSTA:

I was delighted to get your letter and enclosures. You seem to have quite a going organization and if it isn't moving too rapidly I should like to hook on. You will find an application for membership in the Business-Industry Section attached, along with the check for payment. Please let us have "the works."

John Burger, Director
Educational Services
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Mr. Arthur Baker
President of NSTA:

Enclosed find check for 1952 dues. I am sending in two Sisters' names I thought would perhaps be interested if you would send some literature to their schools. I know I enjoy everything I receive from NSTA, and the students make good use of it. God bless your work.

Sister M. Bernadette
Paola, Kansas

"No!" That was the response of Clyde T. Reed, Tampa, Florida, to Arthur Baker's letter appealing to NSTA members to change from regular to sustaining membership wherever possible *because of the wealth of membership services offered.* But Dr. Reed, professor of biology at the University of Tampa, went on to say, "Please *do* change my membership to sustaining simply because I want to promote an organization that stands for continued progress in science education, a critically vital sector of the whole program of general education."—*Editor*

THE SCIENCE TEACHER

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in the March issue of *The Science Teacher*

- "The Need for Sex Education in High Schools"
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- "Better Working Relations Between Secondary and Elementary Teachers in Science"
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(For Officers and Executive Committee See Page 3)

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THE SCIENCE TEACHER

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The National Science Teachers Association is a Department of the National Education Association and an Affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction, the Association later became the American Council of Science Teachers. It merged with the American Science Teachers Association and reorganized in 1944 to form the present Association, and **The Science Teacher** became the Official Journal of the new National Science Teachers Association.

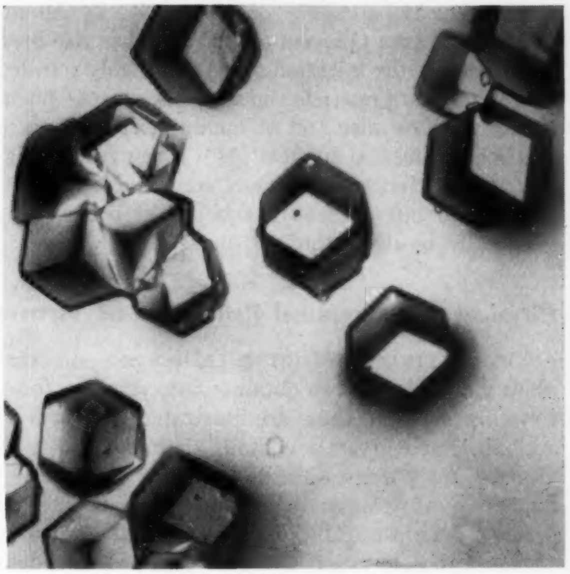


Fig. 1a. Rhombic dodecahedric crystals of tomato bushy stunt virus x 168 (Stanley, W. M. "Purification of Tomato Bushy Stunt Virus by Differential Centrifugation." *Journal of Biological Chemistry*, 135, 437-454).

VIRUSES

By C. A. KNIGHT

Viruses are infectious agents largely characterized by their small size and ability to reproduce only within living cells. These submicroscopic disease agents intrude upon the interest of almost every individual, for probably no one lives an average life span without several virus infections, and the domestic plants and animals of man are likewise subject to virus afflictions with significant annual economic losses. To scientists of many disciplines the field of virus research represents a fascinating frontier where modern techniques and instruments can be brought to bear on a major unsolved riddle of biology, the mechanism of virus reproduction. Attack on this problem may substantially advance knowledge of the nature of life itself since viruses appear to constitute the simplest substances possessing important attributes of life (ability to reproduce and to mutate). Furthermore, the study of viruses has implications in other fields such as in genetics where a striking resemblance between the properties of genes and of viruses has been noted (1-3),* and in cancer research where several plant and animal tumors are known to be caused by viruses (4, 5).

The history of virus diseases extends back into antiquity, but one of the three greatest scourges of human disease was the modern influenza pandemic of 1918-1919 which affected an estimated 500,000,000 people and killed about 15,000,000 (6). There are numerous examples of human viral maladies including smallpox, mumps, measles, yellow fever, chickenpox, influenza, herpes, poliomyelitis, the common wart, dengue, and many more (7). A few common viral diseases of domestic animals are rabies, Newcastle disease of chickens, hoof-and-mouth disease of cattle, hog cholera, and equine encephalomyelitis.

Viruses infect both higher and lower plants, and many of the resulting diseases have been given picturesque names more or less descriptive of the action of the pathogen. Some examples are tomato bushy stunt, aster yellows, sugar beet curly top, little

Members of the NSTA workshop at the University of California last summer were greatly impressed with the informal discussion of viruses by C. Arthur Knight, associate professor of biochemistry at UC. They urged that a paper on the subject be published in *The Science Teacher*. As evidenced by this article, Dr. Knight obligingly found time to accommodate us.

Following completion of his doctorate at Pennsylvania State College Dr. Knight embarked on intensive research on the chemistry of viruses and especially the chemistry of mutation. He carried on his work at the Rockefeller Institute for Medical Research at Princeton University during 1940-48 with Dr. W. M. Stanley and has continued this association at the University of California (Berkeley) Virus Laboratory since 1948. His more than 40 papers in this field of research include presentations at the Sixth International Congress for Experimental Cytology in Stockholm and the Fourth International Congress for Microbiology in Copenhagen.

* Numbers in parentheses refer to bibliography at the conclusion of the article.

Fig. 1b. Needle-shaped paracrystals of tobacco mosaic virus x 506 (Stanley, W. M. "Crystalline Tobacco Mosaic Virus Protein." *American Journal of Botany, 24, 59-68, 1937*).

peach, buckskin disease of cherry, quick decline of citrus, and sudden death of cloves (8). Virus diseases are not limited to higher forms of life, for characteristic viruses have been demonstrated in worms, insects, and even bacteria (9). Viral diseases have not been reported in some groups of plants and animals, such as algae, molluscs, and beetles (9), but at present it seems as reasonable to conjecture that this failure is attributable to shortcomings in the methods and intensity of search as it is to assume that these classes of organisms are immune.

In general, then, it may be stated that viruses are almost ubiquitous, and to this it must be added that adequate controls for these disease agents are unfortunately not yet available. Moreover, in those few exceptional cases, such as smallpox, where reasonable control has been achieved through a vaccine, there is always the danger that mutations may occur, culminating in strains of virus for which the vaccine is no longer effective. Such a sequence actually occurred in the attempted use of vaccines against influenza (10, 11).

On the brighter side, it is hoped that technical advances, coupled with a better understanding of the chemical differences between strains of a virus, may provide the basis for production of better vaccines against animal viruses. Furthermore, certain antibiotic drugs, notably aureomycin, chloromycetin, and terramycin, have proved spectacularly effective against a number of viruslike organisms such as the rickettsiae** of typhus, Rocky Mountain spotted, and Q fevers (12, 13). It has also been reported that the injection of certain highly purified bacterial sugars restricts the multiplication of pneumonia virus of mice and of mumps virus in appropriate experimental animals (14). These results suggest that anti-viral substances, comparable in effectiveness to our present anti-bacterial drugs, may eventually be discovered.

Physical and Chemical Properties of Viruses

CRYSTALLINITY. About a half-dozen different plant viruses have been obtained in crystalline form. Crystals of two of these are illustrated in figures 1a and 1b. Such crystals contain thousands of individual virus particles and are able to maintain infectious quality when stored in the test tube for a period of months. The demonstration that a virus (tobacco mosaic virus) could be obtained as a definite chemical entity possessing para-crystalline† form opened up a whole new field of biochemical investigation. For this discovery, reported in 1935 (15), W. M. Stanley received the Nobel prize in chemistry (16).

SIZE AND SHAPE OF VIRUSES. Each virus appears to possess a characteristic size and shape, but as a group viruses appear to fill the gap in size between the ordinary protein molecules of the chemist and recognized living organisms. This is illustrated on the facing page where the sizes of many viruses are compared with reference materials. It can be seen that the smallest known viruses are about 10 mμ in diameter while the largest of the so-called "true viruses" listed, vaccinia virus, has dimensions of approximately 210 x 260 mμ. The point of a pin is about a twentieth of a millimeter in diameter and yet 500 particles of influenza virus could be lined up across it. This size range is below visibility in ordinary light microscopes but corresponds very well with the optimum working range of the electron microscope (17). The shapes of virus particles revealed thus far by electron microscopy include globular, rod-like, filamentous, and sperm-like forms as illustrated in figure 3.

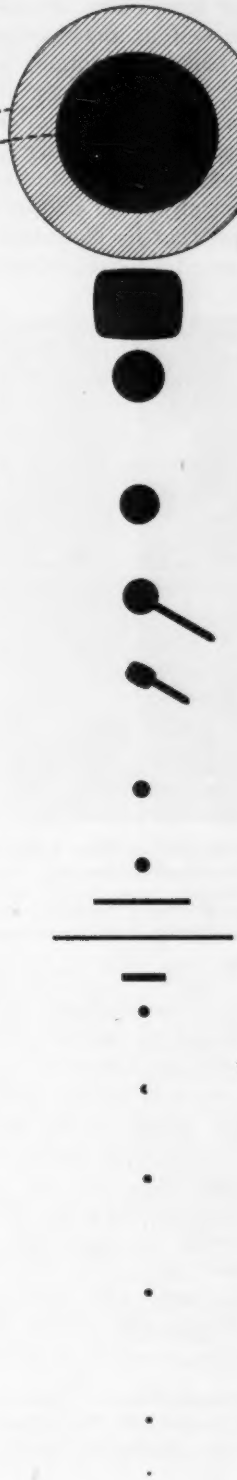
CHEMICAL COMPOSITION OF VIRUSES. There seems to be a characteristic composition for a given virus, but there is considerable variation in this respect among different viruses (18, 19). The plant

** Classification of viruses and similar organisms is at present somewhat arbitrary, but the rickettsial bodies are usually considered along with the so-called "true viruses" since both, in contrast to common bacteria and fungi, require living cells in which to multiply. However, the rickettsiae are larger and are morphologically and chemically more complex than most of the "true viruses"; in fact, the rickettsiae are very similar to bacteria in these respects.

† For distinction between paracrystals and other types of crystals see reference 8, page 209.

APPROXIMATE SIZES OF VIRUSES AND *REFERENCE MATERIALS*

	Diameter or width X length in mμ
Red blood cells	7500
B. prodigiosus (Serratia marcescens)	750
Rickettsia	475
Psittacosis	450
Canary pox	260 x 310
Myxoma	230 x 290
Vaccinia	210 x 260
Pleuro-pneumonia organism	150
Pseudo rabies	150
Herpes simplex	150
Rabies fixe	125
Influenza	115
Newcastle disease	115
Vesicular stomatitis	100
Staphylococcus bacteriophage	100
Fowl Plague	90
T_2 coli bacteriophage	60 x 80
Chicken tumor I	70
Equine encephalomyelitis	50
T_3 coli bacteriophage	45
Rabbit papilloma (Shope)	44
Pneumonia virus of mice	40
Tobacco mosaic and strains	15 x 280
Latent mosaic of potato	10 x 525
Gene (Muller's est. of max. size)	20 x 125
Southern bean mosaic	31
Rift valley fever	30
Tomato bushy stunt	26
Poliomyelitis (Lansing)	25
Hemocyanin molecule (Busycon)	22
Yellow fever	22
Hemocyanin molecule (Octopus)	20
Louping ill	19
Tobacco ring spot	19
Japanese B encephalitis	18
Alfalfa mosaic	17
Tobacco necrosis	16
Foot-and-mouth disease	10



viruses are chemically the least complex, for, while they have molecular weights which may lie in the millions, all of those which have been highly purified have proved to be simple nucleoproteins. Most animal viruses differ from plant viruses in that they contain lipid as well as nucleoprotein. Influenza virus has been found to contain, in addition to nucleoprotein and lipid, a polysaccharide composed of mannose, galactose, and glucosamine units. The lipid of animal viruses may consist of neutral fat, phospholipid, cholesterol, and in some cases all three. The amount of nucleic acid in viruses ranges from about one per cent for Newcastle disease virus to about 40 per cent for tobacco ringspot virus.

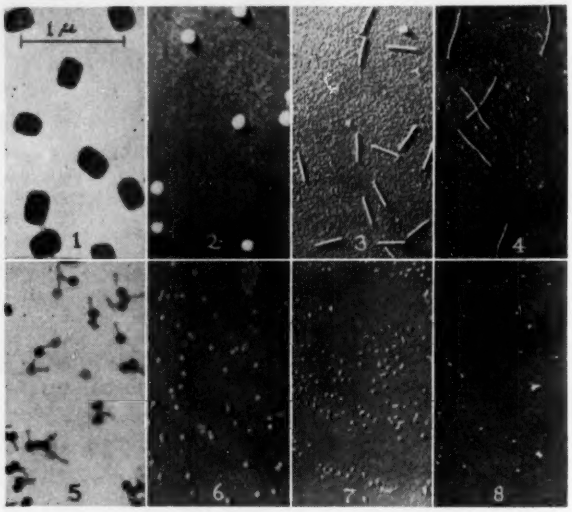


Fig. 3. Electron micrographs of some highly purified viruses. 1—Vaccinia Virus. 2—Influenza Virus (Lee strain). 3—Tobacco Mosaic Virus. 4—Potato-X Virus (Latent mosaic of potato). 5—T2 Bacteriophage. 6—Shope Papilloma Virus. 7—Southern Bean Mosaic Virus. 8—Tomato Bushy Stunt Virus. (See reference 18.)

It seems at present, therefore, that viruses in general are composed of various combinations of nucleic acid, protein, and frequently lipid, with certain other substances appearing only in, as yet, special cases. With regard to the fundamental requirements for virus activity, nucleic acid and protein can be singled out from the various other chemical components, for these two substances combined to form specific nucleoproteins (exemplified by the plant viruses) appear to comprise the minimum chemical requirement for virus activity, and, moreover, nucleic acid and protein constitute the only two components common to all viruses.

Figure 2, "Approximate Sizes of Viruses and Reference Materials," is from: Stanley. W. M., "Chemical Studies on Viruses," *Chemical and Engineering News*, 25, 3786-3791. 1947.

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Literature as Science Experience

Using Mendel's *Experiments in Plant Hybridization* in biology teaching—an example of how classical papers, thoughtfully presented, can be an enriching experience for the bright, science-minded students

By ZACHARIAH SUBARSKY

The science teacher who is given the responsibility of teaching bright, science-minded students is challenged to provide for such students educational experiences in science calculated to develop depth of understanding and appreciation. The teacher provides such an experience when he leads the student to understand and appreciate a classical scientific paper such as Gregor Mendel's *Experiments in Plant Hybridization.* (Copies of this paper, originally in German, are available in English translation from the Harvard University Press.)

Merely to give the paper to a student to read is futile: in the first place, the language is too difficult even for the very bright student; in the second place, the student lacks the background of experience and information needed to understand the text; in the third place, the broad significance of the investigations described in the paper are not readily apparent to the student. To overcome these difficulties, a teaching procedure has been worked out at the High School of Science, a procedure designed to lead the student to an understanding and appreciation of part of Mendel's paper.

> Here is an article which promises "something new" in science teaching techniques, especially in working with the more gifted students. Dr. Subarsky read this paper at the NSTA session Saturday afternoon, December 29, as part of the fourth joint meeting of the Science Teaching Societies of the AAAS, held at the Hotel Adelphia in Philadelphia. The ideas and experience presented elicited considerable discussion and favorable reactions from the 150 attendants at the session. We are pleased to offer these suggestions to all our readers. Dr. Subarsky is chairman of the department of biology and introductory science in the High School of Science, New York City.

1. Providing the framework for the study of Mendel's paper. The unit on heredity is introduced. The variety of possible approaches and meaningful motivation devices for introducing this unit are well known to the experienced biology teacher. The introduction generally includes heredity problems raised by the students themselves—problems such as:

> Are the children of bright parents all born bright?
> If my parents die of heart disease, will I die of heart disease?
> Is being overweight hereditary?

The teacher elicits or states the fact that there is a branch of biology devoted to an investigation of such problems and then asks: "Who was one of the pioneers in this branch of biology?" In a bright class some student is sure to come forth with the name of Mendel—it has never failed. The teacher then elicits or states the fact that Mendel's discoveries were made in experiments with pea plants, and since Mendel's discoveries have shed light on such problems of heredity as were raised by the class, these experiments are worthy of study. But what better way is there to find out about Mendel's experiments than to let Mendel himself tell what he did and saw! At this point a copy of the paper is shown and the date and circumstances of its delivery are noted. The class is informed that since Mendel experimented with pea plants an acquaintance with the pea plant and a thorough knowledge of how the pea plant reproduces is essential to an understanding of Mendel's paper.

2. Providing the background of information and experience. Several laboratory lessons are then devoted to the study of the reproduction of the pea plant, quite in the conventional manner, but with this modification: that throughout these studies the points of information essential to an

understanding of Mendel's paper are emphasized. For example, the terms "keel," "seed coat," and "albumen" are used. The "surgical operation" involved in cross pollination is demonstrated. In studying the fruit and seeds, inflated pods and constricted pods are shown (corresponding varieties of string beans obtainable in the vegetable market will do), green seeds and yellow seeds are shown (green and yellow split peas will do), wrinkled and round seeds are shown (these are obtainable in most grocery stores as dried whole peas). Charts showing terminal and axial inflorescence are shown. Moreover, throughout the study, the name of Mendel is brought in again and again. For example, in showing yellow seeds, the teacher says, "One of the kinds of pea plants Mendel worked with produced yellow seeds like these." The frequent reference to Mendel during the study of floral reproduction serves to keep the purpose of the laboratory work in mind.

Class Studies Idea Development

3. HELPING THE STUDENT TO UNDERSTAND AND APPRECIATE THE PAPER. When the class is ready, copies of Mendel's paper are distributed. The class is asked to imagine itself the members of the Naturvissenschafts Verein in Brunn in the year 1865. One of the students is asked to play the part of Gregor Mendel reading his report. The student reads the first paragraph. (The teacher will find it necessary to explain unfamiliar words like "progeny.") The teacher then raises the question: "Where did Mendel get the idea for his experiments?" This question is designed to stimulate the students to give in their own words the meaning of the paragraph just read. It also gives the teacher the opportunity to lead the class to see that a scientist does not decide to conduct an experiment "out of the blue." Experimentation is the outgrowth of puzzling experience.

The reader (or another reader) then reads the second paragraph after which the teacher takes time out to elicit and emphasize the fact that there was an international group of forerunners of Mendel who "have devoted a part of their lives with inexhaustible perseverence" (words are those of Mendel) to problems of hybridization. Emphasis is placed on the fact that a good scientist first finds out what investigations *others* have made on a problem to be investigated.

The reader (or a third reader) then reads the remaining paragraph of the "Introductory Remarks." The students learn that the report covers experimentation that took *eight* years to complete—twice the students' entire high school career! Here, the teacher takes time out to emphasize the point that one of the traits of a good scientist is patience and perseverence.

The class then goes on to learn, directly from the paper, why Mendel selected the pea plant for his experimentation. The teacher takes time out to emphasize that the wise choice of an experimental plant or animal is an important factor in the success of a biological experiment.

The class then goes on to learn about the varieties of pea plants selected and tested for experimentation and to learn about Mendel's set-up of a series of seven replicative experiments. Here the teacher has the opportunity to point up the "beauty" of experimental design and the ingenuity involved in anticipating extraneous factors that might ultimately obscure the results of an experiment.

The class then reads Mendel's descriptions of the F_1 generation in the series of seven experiments. Here the teacher has the opportunity to lead the class to appreciate how keen and discriminative are the observations of a first rate scientist.

The figures for the F_2 generation are then written on the blackboard and the class left to *discover* for itself the 3:1 ratio. The class is then challenged to give an *explanation*. The class, usually stumped, is ready to appreciate yet another element in scientific genius—the ability to formulate hypotheses to explain the results obtained in experimentation.

Hypotheses Explained and Applied

At this point Mendel's paper is set aside and Mendel's hypotheses are presented by the teacher, namely (1) that each plant inherits *two* factors for each trait, and (2) that the two factors of each pair separate when gametes are formed. An understanding of how these two hypotheses serve to explain the 3:1 ratio is hammered home through the usual "chance" exercises—tossing of coins, blind selection of marbles, etc.

The class, now ready to observe and explain simple monohybrid inheritance in other organisms, is well along in its study of the unit on heredity.

We are now attempting to develop an effective teaching procedure for utilizing William Harvey's classical work in *The Motion of the Heart and Blood,* published in English Translation (from the Latin) by Henry Regney Company, Chicago, Illinois. It is conceivable that teaching procedures could be worked out for other classical papers in the literature, not only of biology, but of other sciences as well. A classical paper thoughtfully presented can be an enriching experience in science for all students.

INCIDENTAL SCIENCE
in the Elementary Classroom

By HERBERT S. ZIM

In the upper realms of education there seems to be a problem concerning the values of a planned program of science versus an incidental program of science in the elementary school. This is not a controversy to bother a classroom teacher who recognizes that both techniques are of value in achieving her goals. However, the classroom teacher who is following the textbook or the course of study has a certain security from these guides while another teacher who is working actively and freely with her pupils may be disconcerted to find the work she has been doing labeled as "incidental." Besides, there is a general feeling that the word "incidental" carries with it the connotation that such work is of relatively less importance than programmed activities and has not been given serious consideration or planning. An incidental program of science teaching is sometimes considered a haphazard program without concern for science objectives and certainly without any graded or orderly sequence of learnings.

People who talk about the incidental study of science sometimes fail to follow through and point out just what science is incidental to. Quite commonly an incidental program of science will be incidental to another subject-matter area within the elementary curriculum. It may be incidental to social studies, or incidental to language arts. This might be the case when the class is reading a story about a beaver, and because of the interest in the story, decides to get more information about how beavers live. There is nothing inherently wrong or unsound in this educational procedure. If one is opposed to incidental science this study of beavers can be made respectable by removing the label "incidental science study of the beaver" and substituting the label "enriched teaching of language-arts."

Another, and more valuable, type of incidental learning is that which is incidental to the life and activities of the child rather than to subject-matter presentation of the teacher. Tony, on his way to school, dawdling beside the stream, catches a bull frog which he brings along to class with him. The teacher, taking advantage of the situation, makes a learning experience instead of a discipline problem out of Tony's contribution. That, too, is incidental science, but the values to Tony and to the class are quite different from the previous example.

In the primary grades, where teachers find it important to develop children's social participation, incidental learning becomes a useful and valuable tool. The things that young children bring to school or the things they want to tell to other members of the group often serve as a basis for rich science experiences. Many primary teachers set aside the first 10 or 15 minutes in the morning as a time when children can "show and tell"—a period when children can exhibit things they have brought to other members of the class and tell about them. These teachers sometimes follow through by providing a table where these objects can be set up as temporary exhibits. This in turn is an inducement to the young child to write the necessary labels, something very important in beginning reading and writing.

Here is some real help for teachers of the primary grades who may be puzzled as to how to incorporate science into their work. Zim's article won't give you a blueprint, though; it's better than that—it gives you *ideas*.

This article also raises some questions that teachers of the upper grades may well consider. How incidental can or should our science be? If it isn't incidental to something, how important and significant can it be? Is it likely that our conventional courses in science, especially at senior high levels, have not "clicked" with so many youngsters because the science is not sufficiently incidental to other problems and values?

Herbert Zim is author of the numerous science books for young people with which most of our readers are quite familiar. He is associate professor of education at the University of Illinois, Urbana.

While most classroom teachers are aware of the social values of this activity, many, I am sure, do not appreciate the tremendous amount of science learning that can come from it. Two classroom teachers, Miss Martha Ewing and Miss Bessie Maxey of Villa Grove, Illinois, kept a record for one fall term of the science contributions made by children of the first and second grades in a small town school. Miss Maxey's group was a first grade; Miss Ewing's a mixed first and second grade. At the end of each day each teacher recorded from notes made during the telling period the contributions, questions, statements, or descriptions of the actual things brought by the six-year-olds and seven-year-olds. The sharing time in this school was generally limited to a short period at the beginning of each day, and it was not a science period as such. All kinds of contributions by children were permitted. The majority did not indicate a relationship to science. There were also cases where the teachers' interpretation of the contribution developed its science aspects instead of others. But, in addition, these teachers recorded a total of 265 voluntary science contributions by their first and second grade children. This averaged over one per day in each class for the school term. Contributions were evenly distributed—145 from one class, 120 from the other.

The range in contributions was even more interesting than their number. They included autumn leaves, potted plants, rocks from a cave, an earthworm, a balloon, praying mantises, a pair of binoculars, seashells, and spiders. One boy brought a snake, another told of his trip to a fish hatchery. Some brought acorns, grasshoppers, a box-turtle, a burnt-out fuse, and corn. Children commented on a rainbow that had been seen on the path of a sunbeam made visible by the dust in the room. One child brought a magnifying glass, another a compass, a third a toy gun, a fourth a magnet. One volunteered the information that it was night in Korea when it was day here; information that was pertinent because his uncle was in Korea. Another noticed the shadows in the school gymnasium and the reflections of the newly waxed floor in the school lunchroom. A look at the records discloses an ample interest in physical science as well as in biological. The range of questions and objects brought to the classroom is literally amazing.

The teachers' utilization of the children's contribution—the part that made a learning situation from them—varied from time to time and with the nature of the contribution. Sometimes the child's own contribution and explanation were sufficient. Sometimes a discussion was begun with other children and the teacher joining in. Often, activities centering around the object or the comment or the question were the order of the day. When a child brought a thermometer, the group had a chance to experiment with it and to see how it worked. They set it on ice; they set it in a warm place in the room; they set it outside the window and noted the change in temperature. They got a thermometer to keep permanently, setting it up so they could read the outdoor temperature from their window. Their teacher made an experimental thermometer for them, using a bottle, a glass tube inserted through a one-hole rubber stopper, and a colored liquid to expand and contract.

One boy brought a toy cowboy "lasso" which embodied a wide rubber band that made a rumbling noise when the "lasso" was spun through the air. The children wanted to know how it worked and in testing it developed concepts of a circle, of the radius of a circle, of things revolving, and the vibrations. To clarify the relationship of the vibrating piece of rubber to the sound, the teacher took the group to the town high school where they borrowed a tuning fork for further classroom experiments. They learned about their own voice boxes and felt, with their fingers on their throats, the vibrations they made as they talked. Fairly soon they had sufficient data to understand how the toy "lasso" (which was nothing more than a modern version of the ancient thunderer) worked.

But this was not enough. The children had already become very much interested in sound, and so the work in this area continued, with the children making a telephone out of two tin cans, asking questions about radio, records, telephone, and other means of communication. Parents brought a wire-recorder to the classroom. Children made records of their own voices, found out about the sound track in a sound movie, and some older boys, in the cub scouts, demonstrated the telegraph and the Morse code. These activities developed into a full scale study of sound, covering as much content and as many activities as if the program had been planned as part of the science curriculum.

The same type and scope of activities went on in both classrooms. In the first grade room, questions about a halloween skeleton led to an intensive study of the body. The children's own ideas of the insides of their bodies were explored first. Based on their concepts and misconceptions, the teacher built up experiences which gave them a more mature understanding of digestion, blood, heart, and bones. In all cases it was the teacher's appraisal of the situation and her decision on how to use it educationally that made the children's contributions important and fitted them into the over-all program of the

grade. Scanning the records kept by these two teachers indicates that a program of incidental science can be wider in scope, richer in experiences, and more significant to children than a program organized and detailed in advance.

Can an average elementary teacher succeed with such a program? The best answer seems to be that the two teachers involved in this experiment were average teachers with the typical training and experience of classroom teachers. Their experiment grew out of work in a single semester course in science education. Perhaps these teachers were above average in being willing to study their own class, accept pupil contributions, and plan and learn with their group. But every classroom teacher can do as much if she wants to try.

Finally, the technique used in this incidental science program was typical of the primary grades. But there is nothing in the technique that limits it to these grade levels. In upper elementary grades, formal activities press for a major part of the class time. Yet many teachers of the third, fourth, fifth, and sixth grades do make time for informal class meetings and in other ways create opportunities in which incidental science may be developed. Each teacher will want to determine for herself how much informal and how much organized science she needs for her group. The two techniques are not only compatible but strongly supplement one another. Since organized techniques are well established and are reinforced by textbooks and courses of study, teachers may want to make a special effort to experiment more with informal or incidental science and to discover for themselves its many rich possibilities in the elementary school classroom.

Using the Community as a Basis For a General Science Unit on Water

By GLEN A. GEISERT

The teaching of general science in the past has been merely the presentation of a group of facts or principles not particularly related to anything, least of all to the pupil and his environment. Trends in science education today demand that the science teacher be concerned with the pupil and his community. Teaching becomes effective when it is rooted in the needs and problems of the people in the community and its schools.[1]

> Many a teacher has struggled with the problem of hinging science instruction on the resources of the local community, all the while assuring that subject matter objectives are adequately served. This article reports an "eminently successful" experience with this type of treatment of a rather conventional unit in general science.
>
> Mr. Geisert was instructor in science in the Hastings, Nebraska, High School, 1947-50; since 1950 he has taught science at Central High School, Pueblo, Colorado. He is married, is an officer in the Naval Reserve, has one summer to go on his Master's degree at Colorado State College of Education, and says his hobby is geology and rock collecting.

In order for the teacher to be able to incorporate the community into the subject that he is teaching, he must know the community. This can be done only by extensive research on the part of the teacher or a teacher-pupil combination. In basing a unit on the community it is necessary for the teacher to do two things to be successful: (1) become a part of the community, and (2) be able to focus on community problems.[2] If the teacher can do these two

[1] Laton, Anita D., and Meder, Elsa Marie. "Toward Unified Learning," *Teachers College Record*, January, 1944, pp. 225.

[2] Evans, Hubert M. "The Teacher of Science and His Community," *Teachers College Record*, January, 1944, pp. 253.

things, he then can start building the course of study for the subject which he is teaching, using the community as a basis.

Four Steps in Developing the Unit

Without the community as a basis for a unit of work, it will be found difficult in many instances to stimulate the pupil in various units of general science. If the pupil can see no relationship between himself or his community and the subject he is taking, it means little or nothing to him. The first way in which the pupil can be made to realize that the unit is important to him is to include the pupil and/or his community in the statement of the main problem used for the unit. Since few textbooks have the main topics in the form of a problem, it is necessary for the teacher to restate the topic in problem form.

Getting away from the traditional type of introductions is the second thing that a teacher can do to stimulate the pupil interest in the unit. The introduction should be conducted in such a manner that problems will arise from the experience. Three methods of introducing units which have been found effective are: (1) using a bulletin board display of pictures under which are placed questions related to material contained in the unit; (2) using a newspaper article of a situation existing in the community that can serve as a foundation for a unit; and (3) using historical and legendary stories about material in the unit showing how attitudes have changed as a result of scientific advancement.

The third tool which the teacher can use is the study guide. The community would be the central theme of the guide. Some subject matter questions should be included in the guide to help the student see the relationship between the community and subject matter. All of the study guide questions should be thoroughly discussed. The amount of material that the teacher would want to grade would depend upon the individual teacher.

The use of desirable activities is the fourth way of stimulating the pupil. The activities include experiments using materials with which the student is familiar and which are common to the community, field trips into the community, and special reports about related problems in the community.

To show how these four steps can be carried out, the general science unit on water has been chosen as an example. Only one method of introduction will be used, that being the bulletin board method. A complete study guide could not be given due to lack of space, and as a result only two of the minor problems will be developed.

1. Restatement of the Topic

The original topic as it might appear in a general science textbook is "Water and Its Uses." The restated topic in problem form might be as follows: Why is water important to me and the community in which I live? This main problem can be subdivided into as many minor problems as the teacher desires. A suggested list of seven minor problems is as follows:

1. What is water and where is it found in my community?
2. What are the important properties of water? What effect do these properties have on me and my community?
3. What effect does running water have on my community?
4. What are the sources of our community water supply?
5. What is the manner of distribution to my home?
6. How is our city water supply purified?
7. How does our community dispose of the sewage?

By using the word community rather than city in most of the problems, the rural areas as well as the urban areas are included.

2. Introducing the Unit

The introduction of the unit on water can be effectively accomplished by the use of a bulletin board display of a group of pictures that are in some way related to the community and water. The interest in these pictures can be aroused by the placing of pertinent questions under the pictures. Ask the pupils to answer the questions. It is not expected that the pupils can *answer* all of the questions, but they should *attempt* all of the questions.

A suggested list of pictures and questions appears below.

1. A snow covered mountain with a lake in the foreground with ice on the lake. In how many states is water existing in this picture? How many possible sources of water do you observe in this picture?
2. A large dam from nearby. What property of water makes it necessary to build the dam so thick at the bottom?
3. Fish jumping out of water. What property of water makes it possible for fish to survive in the watery environment?
4. Drouth in the southwestern regions of the U. S. What region of the United States suffered a crippling drouth during the summer of 1951?

This is only a limited number of the many types of pictures that might be employed to introduce this unit. Actual photographs from your own community could be used very effectively.

After the pictures have been displayed and the questions answered, the pupils should be asked to write down a list of questions that *they* have about water. After the group of questions has been completed, ask them to check the one that they feel is of the most importance to them in their daily life. Through this activity, the teacher has created problems that can be solved during the course of the unit. The teacher is then familiar with problems that the pupils have in relation to this unit.

3. Study Guide and Activities

In this sample of the study guide the emphasis has been placed on the individual and his community in relation to water. The reading material to accompany the guide will have to be worked out by the individual teacher since the same textbook is not used by all of the schools. Therefore, the directions for the use of the guide have been intentionally omitted. Activities that might be used with these two minor problems have been suggested.

MINOR PROBLEM: WHAT IS THE MANNER OF DISTRIBUTION TO MY HOME?

1. If you live in a rural area, how is water distributed to your home?
2. List other possible methods of distribution to rural homes.
3. Check the method that you think is the best. Why do you think that it is the best method?
4. What are the methods of supplying water to cities?
5. How is water stored in this city?
6. How is the water distributed to the residents of this city?
7. What is the method used to provide the necessary pressure for the water system?
8. How many gallons of water are used per day in this city?
9. What is the average daily consumption per person?
10. How do the residents of this city pay for water that is used?
11. What are the advantages and disadvantages of this plan?
12. What problems might this city face in the future in respect to water distribution?
13. How might these problems be solved?
14. What are the uses of water in this area?
15. Check the uses of water that could be eliminated if it became absolutely necessary to do so.

MINOR PROBLEM: HOW IS OUR CITY WATER SUPPLY PURIFIED?

1. What are the requirements for pure drinking water?
2. Do we have pure drinking water according to these requirements? Why?
3. What methods of purification of water supply are used in the rural areas surrounding this city? Why?
4. How is it ensured that the rural supply is pure?
5. What methods of purification are used by cities?
6. Which of these methods of purification are used in this city?
7. How many gallons a day are purified? How much germicide is used for this amount of water?
8. How could our water supply become contaminated?
9. Which of these ways of contamination is the worst?
10. How is the water supply in this city tested for contamination?
11. How often is the water supply tested?
12. What are the minimum requirements for safe drinking water as set up by the state health department?
13. What are the possible results of having an impure water supply?

ACTIVITIES

1. Visit the city storage and water purification facilities.
2. Ask a member of the city water department to talk to the class about local water problems.
3. Conduct simple demonstrations to illustrate the different methods of water purification.

Summary

Many teachers of science believe that it is impossible to integrate the community into the subjects which they are teaching. Other teachers feel that it is too time-consuming to try to develop a subject on the basis of the community. Any new method that is tried will seem to have these two disadvantages. The integration, if tried, will be neither difficult nor time-consuming. It is admitted that more time will be required than that used in developing the traditional textbook method. If the time is given to the development of a general science course with the community as a basis, the teacher will have the satisfaction of having given the pupils a course that is not only more meaningful but more interesting.

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A NEW DEPARTURE
in science teacher training

By NORMAN K. NELSON

Staff Writer, Bureau of Public Information, Duke University, Durham, North Carolina

The value of laboratory experiments in teaching elementary and high school science courses is unquestioned by most teachers. Unfortunately, however, practical instruction for teachers on the preparation and execution of these experiments is not always readily available.

Last summer Duke University in cooperation with the North Carolina Department of Public Instruction sought to meet this need through a Science Teachers' Laboratory Conference. Held at the university July 23-27, the conference was probably the first of its kind in the southeastern United States.

The conference was organized at the request of a group of experienced science teachers from North Carolina high schools. There was, according to these teachers, an urgent need for some type of short training session that would provide them with actual experience in setting up and executing practical experiments and demonstrations.

The basic purpose of the conference was to acquaint science teachers with practical experiments and laboratory teaching procedures which could be used with a minimum of equipment in their own classrooms. Activities of the conference were grouped into two major divisions: physical sciences, directed by the Duke University physics and chemistry departments; and biological sciences, directed by the botany and zoology departments. Conference members were permitted to participate in the activities of one or both groups.

Practical laboratory work by the teachers themselves was emphasized throughout the conference. The physics department offered a variety of projects in three groups: (1) applications of mathematics to physics; (2) radio and electronic circuits; and (3) experiments with motors, galvanometers, optical instruments, and other apparatus. Projects offered by the chemistry department included: (1) the chemistry of photography; (2) properties of solutions; (3) visual aids in chemistry teaching; and (4) experiments designed to illustrate the nature of organic chemicals. Biological science projects included: (1) microscope repair and maintenance; (2) preservation of plant and animal specimens by embedding them in blocks of transparent plastic; and (3) the preparation of experiments in bacteriology.

Daily sessions were conducted in the laboratories of the physics, chemistry, botany, and zoology departments, and each session was supervised by one or more Duke staff scientists. In addition to laboratory work, there was ample opportunity for teachers to meet on an informal basis with a large number of staff scientists, discuss problems with them, hear of newer developments in various fields of science, and exchange ideas and experiences. Films on science teaching were shown, and teachers received mimeographed instructions for carrying out conference experiments.

The conference included a variety of supplementary programs of interest to science teachers. Evening events featured addresses by Dr. Ralph T. Overman of the Special Training Division, Oak Ridge Institute of Nuclear Studies, and Dr. Paul M. Gross, vice-president of Duke University and president of the Oak Ridge Institute. An outstanding display of the conference was an Atomic Energy Exhibit prepared by the Oak Ridge Institute of Nuclear Studies. Other special activities included tours of the university's laboratories and a demonstration of the electron microscope by research workers in the School of Medicine.

Approximately 45 science teachers from North Carolina, Virginia, Florida, South Carolina, and Texas received certificates upon completion of conference work. No college credit was offered, but teachers agreed that the conference aim of providing practical instruction for performing laboratory experiments and demonstrations was successfully fulfilled.

William G. Carr Named To Succeed Willard E. Givens As NEA Executive Secretary

Announcement of the appointment of William G. Carr to the executive secretaryship of the National Education Association was made on January 27 by the NEA Board of Trustees. Dr. Carr succeeds Willard E. Givens who retires August 1 from the position to which he came in 1935 from the superintendency of the Oakland, California, public schools.

Chase News Photo
William G. Carr

Dr. Carr has been associate secretary of the NEA since 1940 and secretary of the Educational Policies Commission of the NEA and the American Association of School Administrators since 1936. He has served as general secretary of the World Organization of the Teaching Profession since 1946. As consultant to the U. S. delegation of the United Nations in San Francisco he worked effectively for the creation of UNESCO and was deputy secretary of the UNESCO conference in London in 1945. In 1947 he was adviser to the U. S. delegation at the second conference of UNESCO in Mexico City.

Dr. Carr is the author of numerous books and articles on international relations, school finance, and school administration. He holds the A.B., A.M., and Ph.D. degrees from Stanford University.

In announcing the appointment, the chairman of the NEA Board of Trustees said that the position is one of the "most influential educational posts in the world. . . . After a nationwide search . . . the board feels sure that it has found the leadership that the teaching profession needs in the years ahead."

All teachers were requested to fill out questionnaires to provide data for improving future conferences. Suggestions asked for included how long future conferences should last and what topics should be covered. The 1952 summer conference is being planned on the basis of these suggestions to provide new experiments which the teachers themselves have requested and to allow more time for informal discussion.

The conference will be held July 21-25, 1952. Information and registration forms may be obtained by writing to the director, Duke University Summer Session, Durham, N. C.

Fellowships and Scholarships

THE SUMMER of 1952 will again provide attractive opportunities for science teachers to gain recognition and assistance through sponsored scholarships and fellowships. Now is the time to initiate steps that may lead to one of these for *you.*

The Graduate School of Arts and Sciences, Duke University, has established 40 scholarships of $100 available on a competitive basis to qualified high school teachers in Alabama, Florida, Georgia, Kentucky, Maryland, Mississippi, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia and District of Columbia. This scholarship program is designed to encourage high school teachers to begin, or to continue, their graduate studies leading to the master's degree. Applicants should address Paul H. Clyde, director of the summer session, Duke University, Durham, North Carolina, requesting official application blanks.

The Westinghouse Educational Foundation will continue its Summer Fellowships for Teachers of Science at the Massachusetts Institute of Technology, providing 50 grants of $250 each. Experienced high school and preparatory school teachers of science who hold college degrees or who have had substantially equivalent training and background may apply by writing to Professor Francis W. Sears, Room 4-356, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

The Westinghouse Educational Foundation is also continuing its program of Fellowships for Teachers of Science at the Carnegie Institute of Technology. The six-week summer program of lectures, discussions, and laboratory work or inspection trips is supported by $250 fellowships. For further information write to the Chairman of Admissions, Carnegie Institute of Technology, Pittsburgh 13, Pennsylvania.

The General Electric Science Fellowships at Case Institute of Technology will recognize outstanding teaching of high school physics for the sixth consecutive year. Fifty of these all-expense fellowships (covering traveling expenses to and from Cleveland, living expenses during the program, books, tuition, and fees) will be awarded for the special six-week program, June 23 to August 1. They are available to science teachers in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Western Pennsylvania, Tennessee, West Virginia, and Wisconsin. Information concerning the program may be obtained from Dr. Elmer Hutchisson, acting president of Case, Cleveland 6, Ohio.

Experiments With An Electrical Network Board

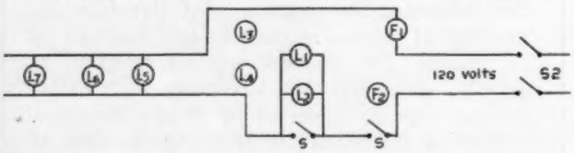
By MARTINUS VAN WAYNEN

Instructor of Physics, Berkeley High School
Berkeley, California

MY ARTICLE in the November issue of *The Science Teacher* promised a follow-up on an electrical network board and what one could do with it. The 100-watt bulbs shown on the board on page 25 in each case light up with brilliances which corroborate the calculated results. What the teacher can do with a board of this sort follows in outline form.

Let us first number the lamps as shown in the following wiring diagram and then calculate the resistance of one of the 100-watt bulbs. Assuming the line voltage to be 120 volts, the current for a 100-watt lamp can be found by

$$I = \text{watts}/E = 100/120 \text{ volts}$$
$$\text{so that } R = E/I = 120/.833 = 144 \text{ ohms}$$



1. With only L_7 in, the bulb receives the full line voltage of 120 volts and glows with full brilliance.

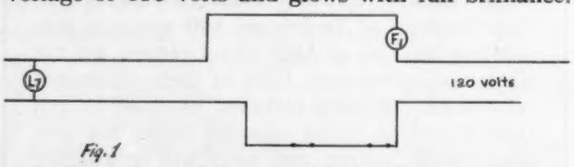


Fig. 1

2. With L_7 and L_6, or with L_7, L_6, and L_5 connected in parallel, each lamp still receives full voltage and glows with full brilliance as in case 1.

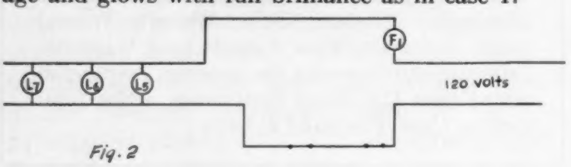


Fig. 2

3. With two in series, each lamp gets 120/2 or 60 volts. The two lamps light up fairly brightly.

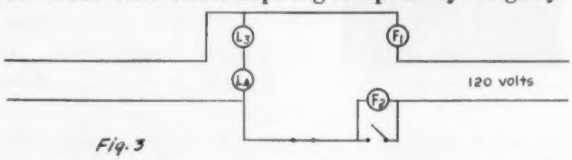


Fig. 3

4. Now replace fuse F_2 with a 100-watt bulb. L_3, L_4, L_2, and L_8 can be connected in series. First, with L_8 out and the switch connected with it closed, the three lamps in series will each account for a drop of 40 volts and will glow dimly. With L_8 in, putting four lamps in series, the voltage drop per lamp becomes 30 volts so that the lamps may barely be seen. By replacing F_1 with another bulb, five lamps in series will be achieved, but in this case the voltage drop is too low to get any perceptible glow from the lamps. In this way pupils should easily learn the principles of a series circuit, at least when the resistances are equal.

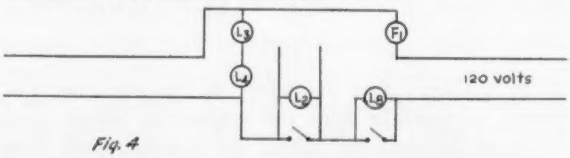


Fig. 4

5. In this case L_2 is connected in series with L_7 and L_6 as shown. The joint resistance of L_7 and L_6 connected in parallel is 144/2 or 72 ohms. This means that the voltage drop in L_2 is twice that in either of the other two lamps. L_2 will be fairly bright while L_7 and L_6 are dimly lighted. At this point in the demonstration take out L_7 so that L_6 and L_2 are in series to see the change in brilliances. Both now getting 60 volts are equally lighted, L_2 becoming less brilliant while L_6 becomes brighter.

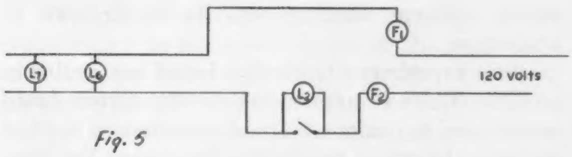


Fig. 5

6. Here L_7 and L_6 are still connected in parallel while L_2 is connected in parallel with L_1 as shown. The four lamps will glow with equal brilliance, although fairly dim, each subject to a 60-volt drop.

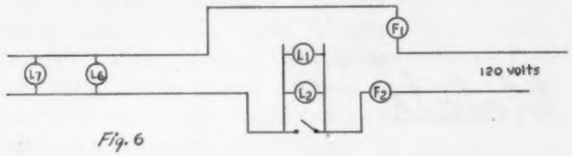


Fig. 6

7. In this network L_7 and L_6 both account for a 120-volt drop while L_3 and L_4 each get 60 volts.

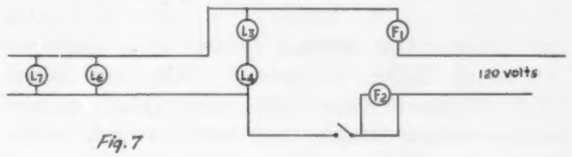


Fig. 7

8. Opening the switch rapidly in this combination will show a slow appearance of glow in L_1 and L_2 and a slow disappearance in L_7 demonstrating the heat-resistance relationship.

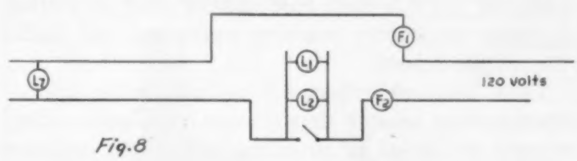


Fig. 8

9. The total resistance is now 144 + 144 + 72 ohms which means that L_4 and L_3 each receive $2/5 \times 120$ or 48 volts while L_1 and L_2 each get 24 volts. L_3 and L_4 glow dimly, and L_1 and L_2 not at all.

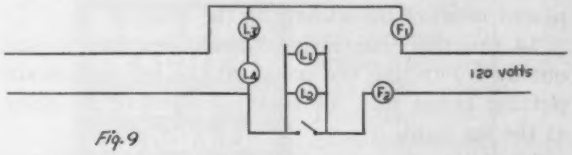


Fig. 9

10. This demonstration is more complicated. L_7 and L_6 connected in parallel are in turn in parallel with L_3 and L_4 in series. All of this is connected in series with the parallel-connected L_1 and L_2. In this case the combined resistance of L_7, L_6, L_3, and L_4 is found as follows:

$$1/R = 1/72 + 1/288 = 5/288$$
$$R = 288/5 \text{ or } 57.6 \text{ ohms}$$

The resistance of L_1 and L_2 combined is 72 ohms. Thus the voltage drop over L_1 and L_2 is $72/129.6 \times 120$ or 66.6 volts. This leaves 53.4 volts for L_7 and L_6, and only 26.7 volts for each of L_3 and L_4. Close the switch shown and discuss the change in the brightness of the lamps in light of what was seen in case 7.

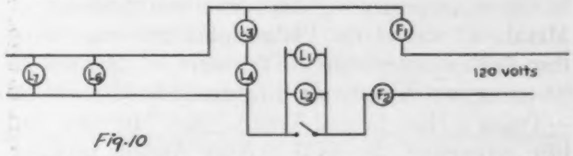
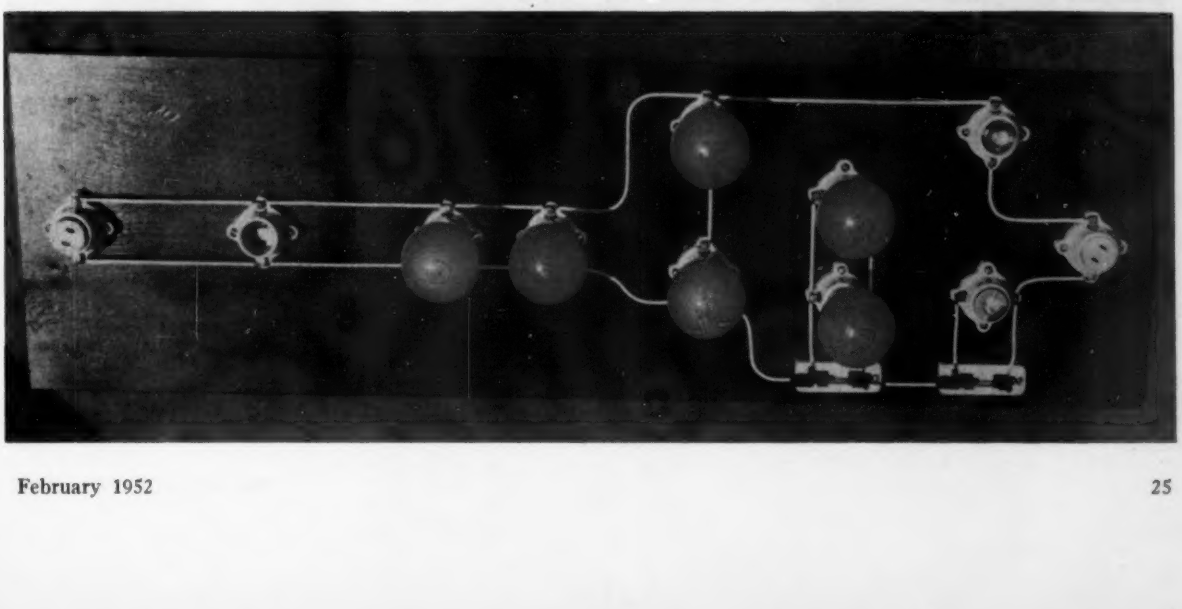


Fig. 10

11. By putting a low amperage fuse in at either fuse plug and replacing L_5 and L_6 by heater elements, one can demonstrate overloading a line and the protection value of fuses. The penny routine can be shown at this point also.

12. Since the wire between L_3 and F_1 is removable, it can be replaced by an iron wire of appropriate size so that it can be made to get red hot showing what an overload actually can do to one's wiring.



13. We will not go into it, but consider the possibilities of the network set up when lamps are placed in all of the sockets on the board.

14. Another interesting circuit can be worked out by connecting the power to the left end, again putting lamps into all sockets including the plug at the far right.

15. Although lamps of different wattage do not lend themselves well to visual demonstration with this board, certain combinations using lamps with widely different wattages may be worked out to advantage.

Other experiments with this board are probably possible. There is no good reason why meters could not be used in conjunction with experiments worked out with the use of the board. This board has been used quite effectively in the experiments given. Its visual value in checking actual results even though approximate should be easily perceived. Why not try it with your class?

American Society for Metals
High School Science Awards

IT WAS A DRAMATIC MOMENT when NSTA President Arthur O. Baker stepped forward and accepted a check for ten thousand dollars from Walter Morrison, representing the American Society for Metals. It was at the Philadelphia meeting during the Friday afternoon NSTA session devoted to "Tomorrow's Supply of Engineers and Scientists —Today's High School Youth." Mr. Morrison had just announced the ASM Science Awards program which will provide five thousand dollars worth of awards to junior and senior high school students, to the science departments of the schools having student winners, and to science teachers or science departments (with or without student winners). He also announced that NSTA had been asked to conduct the awards program and that the invitation had been accepted.

Designed with the broad purpose of helping to increase the supply of needed scientists and engineers, the contest is open to all science students and their teachers in the junior and senior high schools —public, private, and parochial—in the United States and Canada. Details of the awards program, the nature of the student and teacher contests, and how to procure entry forms will be announced in the next issue of *The Science Teacher*.

It is expected also that informational leaflets about the program will soon be mailed directly to schools. At any time, of course, information may be procured from the NSTA headquarters office.

Three thousand dollars in student awards will be distributed as follows. *Senior high division* (grades 10, 11, and 12)—1st award, $500; 2nd award, $400; 3rd award, $300; 4th award, $200; 5th award, $100; six honorable mention awards, $50 each. *Junior high division* (grades 7, 8, and 9)—1st award, $400; 2nd award, $300; 3rd award, $200; 4th award, $100; 5th award, $100; ten honorable mention awards, $50 each. Awards in the junior high division will be in the form of U. S. Defense Bonds.

One thousand dollars will be divided equally among the schools represented by the ten student awards winners in both divisions. It will be expected that the $100 in each case will be used to further increase the science teaching equipment and facilities of the school.

One thousand dollars will be awarded to science teachers (or science departments) for outstanding reports of actual or promising efforts to organize and promote among students either individual or group investigations and projects in science and engineering which would tend to increase interest in the profession with the possibility of selecting it as a career. There also will be two divisions in this part of the program with cash awards as follows. *Relatively small schools*—1st award, $200; 2nd award, $100; four honorable mention awards, $50 each. *Relatively large schools*—1st award, $200; 2nd award, $100; four honorable mention awards, $50 each.

In his letter requesting the NSTA Executive Committee to conduct this awards program, Dr. William Eisenman, executive secretary of the American Society for Metals, said: "The American Society for Metals is the engineering society of the metals industry (23,000 members and about 70 chapters in the U. S.) and consequently is vitally interested in the serious shortage now, and in the future, of graduate engineers.

"The ASM feels that to make progress in the world today, to maintain our present high standard of living and to increase it, to be able to live in happiness and peace—we need more engineers.

"As the culmination of a number of conferences with officers of the National Science Teachers Association, the American Society for Metals desires to solicit your cooperation in a program it believes to be a pioneering step in securing the interest of *both* junior and senior high school students in engineering as a life work—*and* in giving recognition awards, first, to the schools which provide the encouraging atmosphere in which these promising young people are now enrolled, and secondly, to the science teachers who provide the stimulation, instruction, and guidance for these students.

"If a high school graduate is to enter an engineering school, he will have had mathematics, physics, chemistry, and perhaps other sciences—so it is natural to endeavor to secure the cooperation of the science teachers of America to point up the critical need for engineers. We sincerely believe that this cooperative activity will do much to increase the enrollment in engineering schools, and thus eventually produce the proper type of engineer upon whom the future success and security of the world depends."

An NSTA administrative committee to conduct the program has been named and includes Keith Johnson, supervisor of science, Washington, D. C., public schools, chairman; Marjorie Hackett, teacher of general science, Hyattsville, Maryland, junior high school; and Paul Brandwein, head of the science department and teacher of biology, Forest Hills, New York, high school. A committee of reviewers and consultants is now being developed, and its membership will be announced in the next issue of *The Science Teacher*. This committee will be expected to review plans and proposals and offer helpful comments and suggestions.

The Key To Classroom Control in Science

By JOHN G. READ

DISCIPLINE is almost the only trouble of young teachers. Failure to satisfy administrators is not often due to lack of knowledge of subject matter. It is almost never due to failure to be a social and sociable entity in the school. Pupils and other teachers often are high in their praise of a teacher who nevertheless causes "trouble" for the principal or the superintendent. This trouble arises from the fact that youngsters have to be sent from the classroom because they are not doing what the teacher asked them to do. And most of the time they are not doing the classwork because they either do not know what to do, or cannot do what the teacher has asked them to!

This problem will never be solved completely. There will, no doubt, always be individuals who do not want to be in school at all, should not be in a "normal" class, or who for one or two days a year are bound to kick over the traces and be themselves —which is to say the young savage which we all were and would often like to be again.

Let us suppose that the best sort of science teaching is going on. There are demonstrations, visual aids, good texts, and an intelligent, likeable teacher guiding the class in activities which most of the class likes and will do. There comes a time, however, when the individual must engage in some kind of work by himself. Exercises, tests in the back of the chapter in the text, dictionary study, or simple diagrams or charts to fill in—all are devices which should keep the class busy while the teacher has a chance to help individuals. There should be time to pick up the broken threads of understanding, to straighten out misconceptions, and to encourage able students to adventure further in a related project.

As long as the teacher holds the class attention with a demonstration, there is likely to be little disciplinary difficulty. Questions and answer techniques are soon learned. Slow pupils are brought into the discussion. Able students are warned not to jump ahead of the general learning field, then later allowed to show applications from their own broader knowledge and experience. But the teacher who teaches five or six periods a day to perhaps three different divisions and in two or three subjects, is knee-deep in apparatus at the end of the school day. Moreover, he has two or three hours of cleaning up and of preparation for the next day of this marathon. Not only is this program impossible, but he is denying his pupil the chance to take part in the extremely important process of learning for himself. And that involves reading, for the most part, and the use of reading materials.

Whether John Read's suggestions in this article are "*the* key" or "*a* key" to the classroom control, we are confident that they will prove to be helpful to many science teachers, especially those still rather early in their careers. Dr. Read is professor of science education at Boston University. A good share of his time is spent away from the campus, however, since he is heavily engaged as a science teaching consultant and helping teacher. His contacts with the actual classroom situation are numerous and intimate. His background of experience includes many years as a high school teacher, summer camp counselor, science education work at Rhode Island College of Education, and . . . several summers working as a cook in the Howard Johnson restaurants. His son and daughter have both grown up to become science teachers.

It is common knowledge that at any level, from grade four through the college, there will be pupils in the class who are two years, at least, retarded in their ability to get meaning from reading materials. Studies have shown that many science texts present serious difficulty for normal readers at the levels of junior and senior high schools. Textbook salesmen bring back to their home offices the complaints of teachers: "Why are the texts so difficult to read?" "Why don't you put out texts that everyone can read?" "Do science books have to be so hard to read when the science in them can be taught successfully many grades below where we introduce

it?" Tests of reading difficulty, such as the Flesch formula, are not the only criterion to apply to reading difficulty. Based on sentence length and the frequency of polysyllabic words for the most part, they are no assurance of understandability. But good editorial criticism by textbook company readers and by teachers in service has improved the modern science text immeasurably. New texts now out or being written are much more careful of the level of reading difficulty. Elementary science texts are sometimes vocabulary controlled and are certainly eagerly read by slow readers at any level—including the adult. But to get back to the problem of discipline. When the class is engaged in individual, quiet, serious work, there must be things to do that everyone *can* do. No book or series of books will be able to span the enormous range of abilities in the average class. The solution of the discipline problem, then, lies in providing materials for the slow learner, the slow reader, the poor reader, and the very rapid reader. And this means, what every elementary teacher knows, several reading groups, each with its own level of reading.

Select Books Written for Lower Grades

Where is such material coming from? One partial solution is to have science texts that normally will be found two or more grades below. For each topic or unit studied by a class there must be carefully selected books which treat of that same subject at the lower levels. Among all texts available the Row-Peterson series of Unitexts stands out. They are rapidly approaching the point where the major units in science are treated at three levels; primary, intermediate, and junior high levels. They are relatively inexpensive, and the five or six copies needed in any one class would not add up to more than the cost of a single standard text. But they will still not be enough. The teacher should clip and mount reading materials on every unit in science taught through the year. Children will bring in pictures and articles or whole magazines and will often mount them if paper and paste are available. This can be done at home or after school hours. Then the teacher needs to evaluate them in terms of difficulty. He needs to know his science and his pupils. When all the clippings and pictures on weather, for instance, are together, they should be divided into five or six levels of difficulty. A simple numerical or color-code will identify both the subject-matter area and difficulty. A cardboard carton can be a filing case, and the teacher should know that file by heart! He should be able to assign a specific article or picture to a pupil and demand and get some concrete evidence that the pupil has read it and digested it. It may be on the fringe area of knowledge about the topic being taught, but it will be a contribution to the whole class's understanding of the topic. It may be that oral responses from these people will be better than written ones.

Let us not forget the able science students in this work-period. They may have read the text far ahead of the class work. They may know as much or more than the teacher about a specific topic. And for them the upper levels of reading available in the filing case will be eagerly sought and some evidence of their new knowledge can be produced.

Stimulates Out-of-Class Science Reading

All this adds up to something extremely important. Not only is it the key to good classroom management, but with so much science in the public press at so many levels of readability, pupils will get used to learning more about science by themselves. From cartoon strips and books to journals of science societies, there are available in our libraries science materials for everyone. School will stop for many pupils with the ninth or twelfth grade. Science may reach them only for one year or two in school. But new information in science will be presented for the whole life of the pupil, and he will be able to keep up with it only if he recognizes familiar facts and concepts in the new material. His attitude toward science is even more important. If he has been a disciplinary case in the science class, he will tend to dislike the subject and suspect all those who are interested in science in everything he does in his adulthood.

Reading File Yields Good Returns

Make sure that science pupils in your classes have materials which they can use by themselves. Make sure that they can do the assignments you ask them to. Spend the hours of preparation needed to get a reading-file going with the assurance that each hour spent on this project will return you hundreds of hours of better relationships in your classroom.

Anyone who is having disciplinary trouble in his science classes raise his hand! Is this not worth a try? Isn't anything worth a try so that you can go back to teaching instead of policing? And it is not a gamble. Elementary teachers in the lower grades have long known that having suitable reading materials for four or five "groups" is the key to the teaching-learning process. And pupils clear up through grade twelve haven't changed a bit!

PRECIPITATES

Announcements, News, and Views of Current Interest

PROTECTION of school children's eyes is pointed up in a revised 20-page ABC Plan School-Lighting booklet, available as booklet B-4556-A, Westinghouse Electric Corporation, Box 2099, Pittsburgh 30. It outlines six basic points to consider regarding school lighting systems and applies these points to several problems typical to most schools.

REPORTS FROM three "new frontiers" are contained in *Point Four Pioneers*. They constitute a battle report in "the good old fight against man's ancient enemies—poverty, disease, hunger, and illiteracy." May be obtained from Superintendent of Documents, Washington 25; price 20 cents. Ask for Department of State publication 4279.

A NEW projection chart with simple, easy-to-read tables and diagrams which take many of the "make a guess" questions out of the use of projection equipment is available free of charge from the Radiant Manufacturing Corporation, 2627 West Roosevelt Road, Chicago 8. Projection distance and proper screen size, for example, are established over a wide range of values.

NEW AND in full color, four filmstrips on plants, animals, and insects for use in intermediate grades through junior high. Inquire of the Society for Visual Education, 1345 Diversey Parkway, Chicago 14. Each filmstrip averages 48 frames; they are correlated with the Row, Peterson Basic Science Unitexts. Price: $7.00 each.

STERLING FILMS, Inc., 316 West 57th Street, New York 19, has announced its 1952 Educational Film Listing. The free catalog includes more than 250 titles of 16mm sound films in black and white and in color.

"TRAINING BY TELEVISION" is the title of a report on the principal findings of an experimental study which compared training of Naval Reservists by live television with training by recorded television and by standard classroom procedures. Live and "canned" TV were found to be on a par, and in general both were superior to the classroom instruction. The report was prepared by the Navy Special Devices Center in cooperation with Fordham University. The two parts of the report, PB 104414 and PB 105493, may be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25; price 75 cents each. Remit with order by check or money order made payable to the Treasurer of the United States.

"STEEL WITH A THOUSAND QUALITIES" is a full-color, 16mm sound film recently released by the Lebanon Steel Foundry through Modern Talking Picture Service, Inc., 45 Rockefeller Plaza, New York 20. It takes the viewer through steps in manufacture of carbon, special alloy, and stainless steel castings, and the processing of castings from blueprint stages to testing of completed samples. Thirty-eight minutes showing time; users pay transportation charges; somewhat on the technical side.

"CREATIVE TOOLS for the Scientist of Tomorrow" is a catalog of materials and equipment which merits examination by teachers of biology, chemistry, and physics. We repeat a passage from the Foreward page: "If in some small way our materials stimulate interest in the advancement of knowledge by the youth of today we feel that our purpose has been accomplished and we can look forward to a better world tomorrow. For science means knowledge, the knowledge that will free mankind from the ignorance and superstition of the past and that will provide him with the necessary leisure for furthering his own development." To procure a copy, write to Modern Science Laboratories, 8049 St. Clair Avenue, North Hollywood, California.

TEACHERS of elementary school science and general science in junior high schools will be interested in examining latest literature on the "Porto Lab," which provides a handy kit of science materials and equipment. Write to Porto-Sales, Morrisonville, Illinois.

BIOLOGY AND CHEMISTRY teachers will find useful and interesting information in reprints of the scientific papers on the "Iowa Breakfast Study." Recent releases, for example, report comparisons of the cereal breakfast and the isocaloric bacon and egg breakfast from the standpoint of the B vitamins, essential minerals, and nitrogen balance. To request copies, write to Andrew Duncan, Managing Director, Cereal Institute, Inc., 135 South LaSalle Street, Chicago 3.

PRACTICAL suggestions on "Let's Bring Conservation to Life" by John C. Mayfield are to be found in the November-December issue of Scott, Foresman's *Junior Briefs*. Included is an offer of a free wall bulletin board poster, "How Can We Help Conserve Nature's Wealth?" Write to: The Editor, *Junior Briefs*, % Scott, Foresman and Company, 433 East Erie Street, Chicago 11.

NSTA Activities

Nominations — Committee at Work Preparing 1952 Slate

Officers and directors of NSTA are elected by mail ballot each spring, with the closing date of May 10 established by the constitution. Procedures for obtaining nominees as developed by previous committees are again being followed by this year's committee.

All members of the association are invited to suggest candidates for consideration for the various positions to be filled. Send your suggestions directly to the chairman of the committee, Dr. Walter S. Lapp, 724 Derstine Avenue, Lansdale, Pennsylvania. *Do it now* since February 15 is the closing date for such suggestions.

Offices and positions to be filled include *president-elect* (automatically becomes president next year); *secretary* (one-year term); *treasurer* (one-year term); *north central regional director* (two-year term); *southern regional director* (two-year term); and two *directors at large* (three-year terms).

Other members of the nominating committee are Marjorie Campbell, Washington, D. C.; Louise Lyons, Steubenville, Ohio; Arthur Houston, Keene, New Hampshire; S. Ralph Powers, New York City; and J. H. Jensen, Aberdeen, South Dakota.

Summer — Conference of NSTA To Be Held at University of Michigan

Arrangements have been completed for holding the 1952 summer conference of NSTA at the University of Michigan during June 26, 27, and 28, and again to offer science education workshop opportunities in connection with the conference. Francis D. Curtis of the university staff will direct the workshop which will run from June 23 through July 3 and will be organized in two sections: one for elementary school science and the other for high school science. The workshop may be taken for credit if desired. Dr. Curtis is the well-known author of general science and biology textbooks, the digests of investigations and research in science education, and numerous magazine articles.

The NSTA Board of Directors will hold its annual business meeting on June 24 and 25. The meeting is "open," and all workshop and conference attendants are invited to attend the business sessions.

Dormitory facilities and meals will be available to all conference and workshop participants at a rate, probably, of $5 per day.

Planning of the conference is in the hands of a committee composed of Dean Stroud, Des Moines, Iowa, chairman; Harold E. Wise, Lincoln, Nebraska; Dorothy Tryon, Detroit, Michigan; Elbert C. Weaver, Andover, Massachusetts; and G. P. O'Connell, Detroit, Michigan. Two NSTA affiliated groups, the Detroit Biology Club and the Metropolitan Detroit Science Club, will share in program development and in providing the membership for local committees. The names of the latter and the details of the conference will be announced in the March and April issues of *The Science Teacher*.

Membership — Campaign for 1952 Now Under Way

Nearly 300 state and area directors will soon be "carrying the ball" for NSTA in a drive to increase association membership by at least 25 per cent during 1952. This method of promoting membership has been eminently successful in past years; it is now being strengthened and coordinated under the chairmanship of Martin Thames, Bemidji High School, Bemidji, Minnesota. The four NSTA regional vice-presidents are also members of the central committee on membership.

The first task facing the committee was that of obtaining a state director for every state. The state directors are now blocking out definite areas within their respective states and making assignments of area director responsibilities. Meanwhile, regional vice-presidents are undertaking the compilation of a name mailing list of all instructors responsible for science education courses in the colleges and universities within their respective regions. Through the latter, contacts will be established with prospective science teachers, and the sale of NSTA publications will be encouraged.

By referring to pages 45-48 of the January *NEA Journal,* facts and figures for NSTA and other NEA departments may be compared. It is expected that the membership campaign now being launched will soon lift NSTA to a membership enrollment figure comparable to those for the health and physical education group and the music educators. To inject your suggestions and ideas into the campaign or to volunteer your services, write directly to Mr. Thames.

Projects — Involving NSTA and Other NEA Departments Organized

Educational endeavors that cut across conventional subject matter lines are usually considered highly desirable. One of the advantages of departmental status in the NEA "family" is the number of opportunities to participate in such undertakings. NSTA is now engaged in three projects of this nature.

In cooperation with the National Council for the Social Studies and the American Association for Health, Physical Education, and Recreation, a booklet of sug-

gestions for teaching about narcotics is now being prepared. About 15 teachers in each of the fields of social studies, health education, and science teaching have contributed to the manuscript, and the final document is now being edited for publication by Elizabeth Lockwood Wheeler of Mt. Pleasant, Michigan. Dr. Wheeler is a member of the NSTA Board of Directors, is president of the National Association for Research in Science Teaching, and, prior to her recent marriage and return to Michigan, was a professor in the Harvard School of Public Health. It is hoped that one or more grants in aid will make possible the publication and widespread distribution of the resulting booklet.

Through arrangements made with the Federal Civil Defense Administration, six NEA departments brought a team of 30 educators to Washington the week of January 20 to develop one or more manuals of suggestions for teachers and administrators concerning civil defense. Members of the NSTA contingent included Stanley E. Williamson, Corvallis, Oregon; Dean Stroud, Des Moines, Iowa; Dorothy Tryon, Detroit, Michigan; Elra M. Palmer, Baltimore, Maryland; and G. Davis Chase, New Britain, Connecticut. Other NEA groups represented in this project were the Department of Elementary School Principals, the National Association of Secondary School Principals, the National Council for the Social Studies, the American Association for Health, Physical Education, and Recreation, and the National Commission for Teacher Education and Professional Standards.

A report of Eastern Pennsylvania Schoolmasters conference on atomic energy education held last October is now being planned. Again it is anticipated that grants in aid from appropriate industries will be forthcoming to underwrite costs of duplication and distribution of the report. This project is a joint effort of the National Council for the Social Studies and NSTA with the cooperation of Dr. Karl Hartzell of Brookhaven National Laboratory.

A Letter From "Bud" Obourn Tells About Science Teaching in Thailand

Ellsworth S. Obourn, head of the science department at John Burroughs School, Clayton, Missouri, has been on a UNESCO assignment in Thailand since last April. We think we have problems in science teaching in our country—and we do; but Bud Obourn's letter that follows makes things seem not quite so bad. It suggests, too, an honest search as to what we can do to help him and others like him in their work with peoples of other lands who are engaged even more than ourselves in an "operation boot straps." *Editor.*

The Officers and Members
National Science Teachers Association
Washington, D. C.

My dear friends of NSTA:

I want to write to you assembled in Philadelphia and tell you just a few things about science teaching "down

under." I am working here in Thailand this year as a member of a team of four from UNESCO and ten from Point IV. We are attempting to upgrade the educational program and carry out the basic principles of UNESCO for under-developed countries.

Compulsory education begins here about age seven and extends through four pratoms, or grades, to age 11. Secondary education begins with matayom one at 12 and extends through six levels to the approximate equivalent of the tenth grade in American schools. Beyond this are the pre-university levels, sometimes spoken of as matayom seven and eight. Science is in the curriculum from pratom one to matayom eight. The syllabus in the four levels of the primary school represents a pretty good variety of general elementary science. In the secondary school the program consists of six years of general science, so called. It is actually only segments of physics, chemistry, and biology with most emphasis on the physical sciences. The plan is to teach topics from each of these sciences each year with little or no concern for difficulty gradation. For example, the children learn the vernier and micrometer calipers in about the sixth grade. The courses are taught with no regard for the functional values for the students, and the memorizing of content is the chief end of their science education. The educational system is highly centralized and rigidly controlled by set examinations all along the way.

Many of the primary school teachers are poorly trained. The secondary teachers are somewhat better but still far from adequate. If a boy or girl from the provinces wishes to complete the pre-university levels of education he must come to Bangkok. There are 26 provincial teacher training colleges and seven in Bangkok. The provincial colleges train only primary teachers while all secondary teachers are trained here in Bangkok. The teachers college in the provinces are only 11 years old. I have seen a sampling of them, and they are quite inadequate. Despite the fact that three years of biology, physics, and chemistry are taught in these institutions, there are no laboratories, no textbooks, practically no equipment, and no reference books of any sort in the libraries. The situation in the teachers colleges in Bangkok is not as bad but still is far from good. It is generally true that the secondary and pre-university schools are better equipped and better staffed for science teaching than the teachers colleges.

The lecture method of instruction is used almost to the exclusion of any other from the earliest years of the primary school through the university. This is in part due to the lack of equipment and textbooks.

One of the principal objectives of our mission here is concerned with a pilot project in a rural provincial area about 100 kilometers from Bangkok. Here we are working in the most primitive, yet a typical, educational environment. This pilot project is planned for a period of ten years, and it is hoped that at the end of that period some findings will be applicable to the other provinces of the country. We are attacking all phases of education, including health, agriculture, community, adult, and academic. On the academic side we are ranging from the infant school through the teachers college levels.

It is difficult to know just how to give a clear picture of the work that has been started in science education because the problems are so numerous and so diverse—but I will try to give you some idea. In our pilot project at Chachoengsao we have been conducting a program of in-service education for teachers from the primary school through the teachers college levels. This has involved helping them learn other techniques of science teaching than the lecture method, fixing up the ordinary classroom for teaching science, building simple equipment, making surveys of the local community for resources, etc. This in-service work has been conducted through close supervision and with repeated demonstration teaching by the Thai supervisor. We also have selected a key science teacher in each school to supervise and demonstrate when the supervisors must be at another school, perhaps three hours distant by river launch.

We began holding a monthly conference for science teachers. After the first meeting a request came from the teachers to hold these each week. Much good work has been done in these conferences despite the language barrier. We discuss purposes, methods, and materials. Usually some teacher will put on a demonstration lesson, and it is discussed; or someone demonstrates a new piece of equipment such as a pump made from bamboo. Soon the secondary school teachers were coming to this meeting and then the lecturers from the teachers college, so we had to divide the group and meet the secondary teachers and teachers college lecturers every other week. Within the past month this plan has been expanded and now the entire staff conducts a workshop for all teachers in the project one afternoon each week.

At present there are ten schools in the pilot project. This will gradually be extended to include all schools in the province. In two schools space has been found so science may have a separate room which is used by all classes. Gradually we are building up the materials and equipment. A demonstration table has been built for each of the two rooms, and the other necessary materials are being obtained. There are now several aquaria, terraria, animal cages, bird cages, insect cages, a weather station, bird feeding station, and a museum shelf. The pupils are very good and stay after school to care for animals or to help in building a new cage or some simple equipment.

In each classroom of the other eight schools (grades one to four in each school) there is at least one acquarium, a weather station, a bird feeding station, a museum shelf, and some simple equipment.

In a previous letter to Mr. Carleton I spoke about the fact that in the teachers college I found a deplorable condition. Three years of physics, chemistry, and biology being taught with no laboratory, no lecture room, no equipment, and no textbooks. The first step here was to design a laboratory and lecture room. For an expenditure of less than $300 using local labor, we have a laboratory for 40 students with tables and stools and glass-front cabinets with laboratory tops, a lecture

room with demonstration table, and a teacher preparation room with cabinets and laboratory tables.

The students have made or secured considerable equipment from the local surroundings. The lecturers have written directions for ten laboratory experiments, and these are now being performed by the students. The lecturers are now using some demonstrations in their teaching. UNESCO has given $2400 worth of equipment for this college, and this is now enroute. Soon we hope to have an effective course in science.

A course in methods of science teaching has been instituted. This was taught by the supervisors for one quarter but has now been turned over to the Thai lecturers. Along with the methods work a laboratory practicum for all third year students has been put in. This course is just developing. At present students are making about 30 different pieces of simple equipment to form a kit which they may take out into the provinces with them when they graduate in April.

Now for a word about Bangkok. Here I have been working with the teachers college and with three in-service groups of teachers. My work consisted of teaching a course in science methods one hour per week in six training colleges and conducting a two hour work shop for one group of secondary school science teachers, another group of pre-university science teachers, and a three-hour seminar for the lecturers in the teacher training colleges. The program in the teacher training colleges has been about the same as that reported above for the pilot project. The workshops and seminars have been utilized for curriculum problems, work on methodology, equipment, and some individual problems. The methods courses in the teacher training colleges is now being turned over to the lecturers who have been observing for one quarter.

Another interesting part of my work has been with the Science Society of Thailand. After several months of deliberation with the officers, plans were consummated for the organization of a section for science teachers. It seemed wise to begin as a section of the Science Society because an earlier attempt to form such an organization without some sponsoring organization had failed. The Science Society planned a series of six refresher lectures on science at Chulalongkorn University before announcing plans for the organization. These meetings were held once per week and proved to be very popular. A planning and organizing committee was then set up, and finally a meeting of teachers was called. There were well over a hundred teachers present at the organization meeting, and now there are more than two hundred members. We are now in the midst of the four-day annual meeting of the Science Society. The science teachers section is taking an active part. At this meeting there is one of the finest exhibits of science work I have ever seen. Students in science from the earliest grades through the university have displayed their work. Most of the exhibits are operated and explained by the students.

Soon we are going to formulate long time plans for the science teachers organization. Two projects are about ready to get under way, one on science clubs in the schools, and the other the beginnings of a science teachers section in the monthly journal of the Science Society. Another project is the establishment of a science teacher center or institute here in Bangkok. I will write more in detail about this project in a later letter to the journal.

I have been wondering about, and should like to propose for the consideration of the officers of NSTA, the idea that our strong American group might in some small way sponsor this group here for a year or two until they get on their feet. I am confident they would welcome anything NSTA might be in position to help them with. As I have thought about it, it occurred to me that NSTA might send their journal for a year or two (if no funds are available I will be happy to finance this), also I thought that one of our packets might be sent each time. If there are any publications available at headquarters either of a professional or commercial nature, such would be welcome as we begin the formation of a reference library. This is a land of no textbooks, despite the fact that English is read by most of the science teachers. I have wondered about the still good, useful copies of science books that are displaced each year by new adoptions all over the country. We could use anything from elementary books to books at the teachers college level.

I trust that this letter will give you some idea of the problems in science teaching in one of the underdeveloped areas of the world and what we in UNESCO are trying to do to solve them.

Sincerely yours,

ELLSWORTH S. OBOURN
Bangkok, Thailand
c/o Ministry of Education

Elementary Science Conference

"What Can Elementary Science Contribute to a Troubled World?" will be the theme of the program of the annual meeting of the National Council for Elementary Science starting Saturday, February 9, at Boston. Sessions will be held Saturday and Sunday at the Copley Plaza Hotel and at Wheelock College. A science exhibit will also be open at Wheelock College Saturday afternoon.

Highlight of the meeting will be a luncheon at the Sheraton Room, Copley Plaza Hotel, Saturday at noon. Robert Ulich, professor of philosophy, Graduate School of Education, Harvard University, will speak on "Science and Democratic Education in the Elementary School." Reservations may be made in advance by writing to Clark Hubler, 67 Francis Street, Brookline, Massachusetts.

Additional information and complete program details may be obtained from Paul Blackwood, assistant specialist for science education, Elementary Division, U. S. Office of Education, Washington, D. C.

BOOKS BOOKS BOOKS BOOKS Review

DESIGN, CONSTRUCTION AND OPERATING PRINCIPLES OF ELECTROMAGNETS FOR ATTRACTING COPPER, ALUMINUM AND OTHER NON-FERROUS METALS. Leonard R. Crow. 38 pp. $1.00. The Scientific Book Publishing Company. Vincennes, Indiana. 1951.

THE RATHER formidable title clearly states the text of this short treatise. The explanation of the principles of a magnet that attracts non-ferrous metals is developed step by step from the basic principles taught in high school physics. One reading should suffice to master it. Teachers of physics, especially, should be familiar with this new application of our magnetic theory.

Although nothing is said in reference to the practical values of a non-ferrous metals magnet, one can easily see the manifold possibilities of a device that can easily differentiate between the various metals. Imagine the curiosity that could be stimulated by it in the classroom and especially in a school science show or exhibit.

M. VAN WAYNEN
Berkeley High School
Berkeley, California

HIGH SCHOOL PHYSICS. Oswald H. Blackwood, Wilmer B. Herron, and William C. Kelly. 670 pp. $3.76. Ginn and Company. New York. 1951.

A NUMBER of features commend this textbook for use in high school classes. The fact that two of the authors are members of the University of Pittsburgh physics staff insures its soundness and accuracy. The multitude of teachable features are presumably due to the influence of the high school member of the team of authors. These teaching aids include point-by-point chapter summaries, solved problems, optional experiments for the abler students, a series of self-tests, topics for class discussion, and a glossary of important terms.

One of its most commendable features is the inclusion of about 400 unusually clear drawings. These are supplemented by approximately 250 photo illustrations. Its 16 large photographs in color are outstanding.

In addition to dealing with the traditional units of mechanics, heat, sound, light, and electricity, the book takes cognizance of the times and includes a well-rounded unit entitled "Electronics and Nuclear Physics."

ROLLAND J. GLADIEUX
Kenmore Senior High School
Kenmore, New York

EXHIBIT TECHNIQUES. Helen Miles Davis, Editor. 112 pp. $2.00. Science Service. Washington, D. C. 1951.

EXHIBIT TECHNIQUES has been prepared especially for science teachers whose students have never put on a public show. Each student-made device described has already excited the interest—or even the awe—of parents and neighbors in one or more science fairs. Many of the projects related have won prizes in the past and could win again.

The items described in this volume are not only numerous, but varied as well. They touch almost any amateur interest or hobby. A star projector, a seismograph, a Geiger counter, culture for spirogyra, a bird census, mollusk collection, chromatographic tubes, a stroboscope, lab-made liquid ammonia, modeling media —name your pet project and find out how to put it on display. The need for different levels of ability in building devices is fully recognized.

Exhibit Techniques will serve any high school science teacher who is ambitious for his students, and enjoys the praise they will receive for originality and good performance in public. The science fair has proved its good-will value. Science Service is to be congratulated on putting Mrs. Davis' talents to work in planning and producing this real aid to increasing a community's respect for science and good will toward its school.

HANOR A. WEBB
George Peabody College for Teachers

YOU AMONG THE STARS. Herman and Nina Schneider. 56 pp. $2.25. William R. Scott, Inc. New York. 1951.

A BOOK which will give boys and girls the answers to their many puzzling questions concerning the earth and its place in the universe. It will also serve as a guide to the teacher who is a little uncertain when teaching "up" and "down," as well as when explaining the many phases of astronomy. The vocabulary is simple and easily understood by fourth- and fifth-grade children. Good analogies, which are a part of childhood experiences, help clarify the more difficult material. An attractive and eye-appealing format is offered. Blue, white, and yellow lithographs effectively illustrate and explain the concepts presented in the context. This is an excellent book to add to the library shelf for interesting and accurate information.

FLORENCE E. LEARZAF
Pittsburgh Public Schools

Teaching Science to Children. Julian Greenlee. 57 pp. $1.50 (paper bound). William C. Brown Company. Dubuque, Iowa. 1951.

Dr. Greenlee's book should prove helpful source material, particularly in school systems where no course of study in elementary science has been developed. Since the emphasis of the book is largely at the primary level, it will be suggestive to teachers working on a flexible, integrated program.

Chapter I helps teachers to understand young children and their needs. It points out that the science program should fit the needs of the children and help them to solve problems important to them. The remaining chapters deal with content and suggested methods for making it meaningful to children. The content is organized under broad areas of science.

The following chapter headings suggest the scope of the material: "Children's Experiences With Living Things"; "Children's Everyday Experiences"; "Children's Experiences With Soil and Rocks"; "Children's Experiences With Space Concepts"; "Children's Experiences With Mechanics"; "Children's Experiences With the Atmosphere"; "Children's Experiences With Temperature Controls."

The table of contents makes it easy to locate a specific problem under any one of these larger areas.

Grace Maddux
Elementary Science Department
Cleveland, Ohio, Public Schools

Billy Bass. R. W. Eschmeyer. 47 pp. $1.25. Fisherman Press, Inc. Oxford, Ohio. 1951.

The life story of the black bass is interesting and informative reading for children of the intermediate grades. The factual material, presented in a simple, direct way, answers the questions children invariably ask about the growth, food, activities, and hazards of animals.

The reader also learns important facts about fish conservation. The effect of siltation and pollution on the life and food of the bass, as well as good practices in the management of fish, bring out the real meaning of conservation.

Marjorie H. Campbell
Department of Elementary Science
Washington, D. C., Public Schools

Water, Land and People. Bernard Frank and Anthony Netbey. 331 pp. $4.00. Alfred A. Knopp. New York. 1950.

The book is a reliable presentation of the complicated interrelationships of water, soil, biological resources, and modern society, both rural and urban. It is extensively documented by a reference list of 16 pages plus nine pages of special bibliography. It is not a textbook on the technology of conservation but a convincing case against unintelligent practices in utilizing our natural resources and the consequent threat to our individual and national welfare, even our very existence. Forty-one pertinent illustrations strongly support the

up-to-date facts presented and the constant appeal for individual, political, and social cooperation to prevent bankruptcy and national disaster. The authors not only delineate the problems and set up the costs but also propose methods of correcting and controlling those circumstances out of which misuses and abuses arise.

Every American would, or should, in this reviewer's opinion, be a better citizen after reading this book, and certainly every teacher in America should be acquainted with the facts which it contains.

For perspective, stimulation, illustrative cases, and an appreciation of the broad aspects of conservation, the book is strongly recommended for use in junior and senior high schools and colleges.

CLYDE T. REED
University of Tampa
Tampa, Florida

NUTRITION FOR HEALTH. H. F. Kilander. 415 pp. $3.00. McGraw-Hill Book Company. New York. 1951.

ALTHOUGH this book is written primarily as a high school text, it might well be recommended as a rich source of authentic information for the layman as well. It portrays in concise, nontechnical language the elements of nutrition and its relationship to normal healthy living. The latest scientific findings are presented with a logic that appeals to teenagers. The reader is given a clear understanding of the basic food groups and the elementary facts of digestion as a background for the scientific principles involved in food selection, meal planning, and personal dietary problems. The relationship of soil fertility to the quality of foods, conservation and the nation's food supply, and sanitation and food laws is also considered. An interesting discussion of food superstitions and common misconceptions about food furnishes enlightenment on fads and customs of both the past, as well as of the present.

The book is well organized with activities that correlate the factual material with the food habits of the reader. It might be used profitably as a text for health education, home economics, general science, biology, or as general supplementary reading.

LYDIA ELZEY
The Pennsylvania State College

BIRDS OF MONTEZUMA AND TUZIGOOT. Henry H. Collins, Jr. 12 pp. $.25. Distributed by Southwestern Monuments Association. Santa Fe. 1951.

THIS ATTRACTIVELY prepared pamphlet is the first in a series planned to be published on the various nature subjects relating to national parks and national monuments. It gives a description of each of the more important birds that one is likely to see at the two monuments in central Arizona. The beautiful illustrations are from the drawings and paintings by the noted bird artist, Roger Tory Peterson. Six of them are in full color, including the cover picture showing a pair of brilliant western tanagers.

Other features of the pamphlet are a Bird Quiz, Suggestions for Visitors, Localities in the Monument of Interest to Birdwatchers, and a Check List of the Birds of Montezuma Castle. A locality map shows how to reach these national monuments by highway, and it also shows the other national monuments and national parks in Arizona and southern California.

Having extremely simply written text, the pamphlet is designed to bring a new pleasure to monument visitors who previously have taken no interest in birds, as well as to help the amateur ornithologist.

DEVEREUX BUTCHER
National Parks Association
Washington, D. C.

CLASSROOM ideas and demonstrations

Chemistry

Stimulating Junior Research in Chemistry

By HARRY H. WILLIAMS, Teacher of Chemistry and Director of Instruction, Horace Mann School, New York City

This brief account of how one teacher helped one student get started on a line of junior research may be helpful to other teachers confronted with similar situations.

In recent years I have conducted my chemistry laboratory work on the pattern of a reduced number of required laboratory exercises and a maximum allowance of time for individual choice of approved activities. The required 12 to 15 exercises have been chosen for the purposes of helping the students become acquainted with the more common elements and reagents and the most frequently used laboratory apparatus and techniques, and to afford practice in developing skill with respect to the latter. The required experiments may be done at each student's own pace, but every student must secure the instructor's approval of his performance of all the experiments before he is given permission to move into the second type of laboratory work.

As the year progresses the students do, from time to time, sandwich others of the directed laboratory exercise in between their laboratory activities of a more experimental nature. They are then allowed to choose from the variety of so-called experiments in their laboratory manual. When his careful examination indicates that little is to be gained from doing a laboratory exercise, the student is advised to skip it in favor of one that has more to offer.

Each year, of course, there are a number of students who choose to continue with their regular laboratory book, performing one experiment after another according to directions. But the majority of students prefers to undertake experimental projects or to engage in what is for them truly junior research.

On one particular occasion a boy who had satisfactorily completed the required preliminary exercises expressed a desire to do some special work but had been unable to "think up a good problem." We talked a bit and both agreed that his one or two ideas did seem rather inconsequential. Finally I suggested that as a starter he might leaf through his chemistry textbook and pick out one reaction that he could carry out in the laboratory on a quantitative basis, and that he might find it interesting to make a comparison of experimental and theoretical yields.

He accepted the suggestion and finally settled on the reaction of lead nitrate with hydrochloric acid. But he was soon back for help after his first trial, which gave a yield of less than 30 per cent of theoretical. My answer, of course, was to try it again and this time be more careful at every stage of procedure. But the yield was almost the same as in the first trial. A third run was another repeat performance.

At this point we sat down together for a closer look at the problem. A reference book or two from those available in the chemistry room—and he had a clue to the answer: the formation of soluble complex ions of lead in the presence of excess hydrochloric acid.

This unexpected turn of events was sufficient to set this boy off on a special study of complex ions that held his interest for three months. At an

appropriate time as the course progressed he became the expert and "lectured" the class on reactions in solution and the formation of complex ions.

This is just one case study to be sure, but it is an example of the potential values that are there if we loosen up a bit on the traditional.

General Science

Let's Make a Rain Gauge

By M. F. VESSEL, Professor of Science Education, San Jose State College, San Jose, California

One of the essential instruments for classroom weather study is a rain gauge. Most schools cannot afford to buy such an instrument and the frequently used home made rain gauge consisting of a funnel and a mayonnaise jar is almost useless. You cannot set out a bucket and measure how much rain fell, for the amount of rain collected during any one rainfall is too small to be measured successfully. Here's a simple yet accurate instrument to measure rainfall which can be made for about 50 cents.

The standard manufactured rain gauge which uses a dip stick consists of a funnel and a cylinder arrangement. The ratio of the *area* of the funnel to the *area* of the inside cylinder is ten is to one. This makes it quite easy to measure the rainfall collected because the cylinder contains ten times the actual rainfall, and the measuring dip stick is calibrated in tenths and hundredths of an inch.

To make a rain gauge comparable to the manufactured type you will need: (1) a plastic funnel about 3″ or more in diameter; (2) a tall narrow bottle such as an olive bottle; (3) an unpainted stick (a ⅜″ soft wood dowel works well); (4) to borrow a graduated cylinder for measuring liquids in the metric system.

First of all you may have to review some mathematics. The volume of a cylinder can be obtained by following the formula $V = \pi r^2 h$. Because it is easier to compare *volume* and *linear* measurements in the metric system than it is in the English system, we will adapt the formula to the metric scheme. So:

$V =$ volume
$\pi = 3.14$
$r = \dfrac{\text{diameter in centimeters}}{2}$
$h = 2.54$ centimeters (this equals 1 inch)

Suppose that the funnel you bought has a diameter of three inches. (This is 7.6 cm., for each inch equals 2.54 centimeters.)

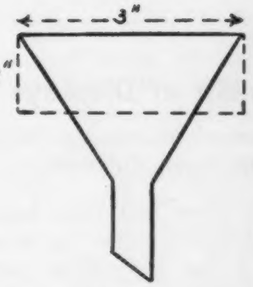


Fig. A

Let us assume that one inch of rain fell and it was collected by this funnel. This would fill a *cylindrical* dish one inch deep and three inches in diameter as shown by the dotted lines in figure A. Using these figures we can now make our calculations to find out how many centimeters of water are contained in this inch of rain.

$V = \pi r^2 h$
$V = 3.14 \times 3.8 \times 3.8 \times 2.54$
$V = 115.3$ cubic centimeters


Fig. B

Next measure out 115.3 cm. of water with the graduated cylinder and pour this water into the olive bottle you plan to use for a rain gauge. (If the inside bottom of the bottle is too irregular, it would be well to melt some wax into it and make a flat surface.) Suppose that the water you measured and poured into the olive bottle looked like the sketch in figure B. Measure the height of this column of water by inserting the measuring stick. Now divide the distance

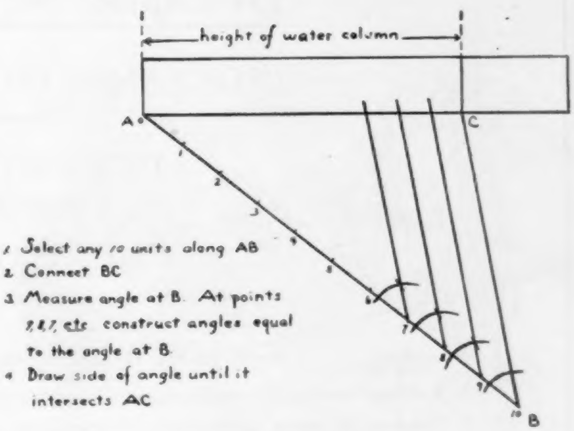


Fig. C

measured on this stick into ten equal parts.* You now have a funnel, a bottle, and a measuring stick which will measure rainfall accurately to tenths of an inch or better.

*One of the easiest ways to divide a unit of length into ten equal parts is to use the system of equal angles and parallel lines as shown in figure C.

General Science

Effective Arrangement of Displays

By VERA W. TROESTER, Science Instructor, Van Nuys Junior High School, Van Nuys, California

In business sales records show that sales have been greatly increased when merchandise has been well displayed. Perhaps a few suggestions and techniques in science room arrangement might be helpful in "selling" science to youngsters.

We might ask ourselves:

In what ways should the science room as a physical setting achieve aesthetic values?

- Positive Factors:
  - Cheerful, pleasant, interesting and functional
  - Sometimes a science room is interesting, but it is unorganized and cluttered
  - Backgrounds in neutral colors or colors in harmony with the display
  - Plants, cages, etc., must be given enough room to relieve clutter
- Negative Factors:
  - Too many specimens displayed at one time
  - Background may overshadow display
  - Specimens in all sizes and shapes of containers

What qualities should characterize a well arranged science room?

- Pointed use of materials
- Orderly arrangement
- Simple displays
- Change exhibits and displays once in a while
  - Introduce new and special exhibits
  - Arrangement of a special exhibit as a means of arousing interest in some topic which would have made a mere routine lesson

What part can pupils take in room arrangement?

- Pupils assist in planning, care of tackboards, and exhibits
- Display work not always arranged by same group
- *All* pupils should be encouraged to help in preparation and "setting up" of displays

Some suggestions to follow in setting up a pleasing room are:

- Plan exhibit
- Make simple diagrams of plans on paper
- Study good examples of displays in modern stores
- Analyze, as to design, colored pictures from *Fortune* and other good periodicals
- Blackboards and chalk boards occupy a very prominent space in any classroom.

Displays in other parts of the room will be improved if they are kept clean when not in use

Spaces above blackboards should not have pictures strung out in single file, but should be well grouped

Lettering for tackboards or bulletin boards and display cases:

Simple block letters are best
- Timely and good in design
- Easily read

Letters may be cut from light pasteboard or colored construction paper, using a pattern

Purchased letters: Plaster or pasteboard

Cut-out letters can be saved in envelopes to be used again

Titles should be centered
- Lay out letters of title on plan
- Count letters and spaces
- Measure space where title is to be placed
- Find middle of space and start at this point to pin letters from center out
- To get a 3-dimensional effect, letters may be pasted on celluloid or plastic. Effective when used in glass cases

Materials for Tackboards:

Organization—divided into three divisions
- Current science
- Unit of science being taught
- Division for general school matters

Arrangement of Materials on Board:

Materials arranged as a unit

Have pictures and clippings even at the top

Pictures and pupils' work mounted on neutral mats or mats harmonizing with color in picture

In mounting pictures, entire back surface of picture covered with paste

Place picture on mat and smooth from center out to remove air bubbles

Picture may be centered on the mat, or with top and side margins of equal width, and the bottom margin wider than the others

Materials should be arranged with regard for structural lines of bulletin board

Materials should be *pinned* at corners, not thumb-tacked

Room displays in cupboards and on side tables:

Each unit grouped in an orderly manner such as:

animals in one group, plants in another, etc.

Do not display too many specimens in one group.

A balanced aquarium is large enough to be a unit in itself

Design applied to display:

A simple abstract design in background helps the student to an awareness of the realistic

Abstract means basic—as showing way a tree grows

Diagrammatic background, such as stylized volcano back of a rock display lends interest

In placing the display it helps to remember that you always have something satisfying if you follow the pattern of a simple triangle

Caution—restraint! too many things in a display —very confusing

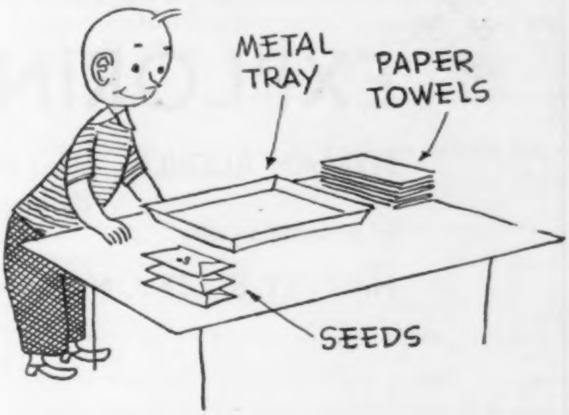
Elementary Science

Germinating Seeds

By DWIGHT SOLLBERGER, Head of the Science Department, State Teachers College, Indiana, Pennsylvania

With the growing season nearly always "here" in many parts of the country and "just around the corner" in many other parts, youngsters in the elementary grades will find timely interest in an experimental study of germinating seeds.

Materials needed for effective *experimental* study include: a large metal tray or cookie sheet; paper towels; and seeds of various kinds, such as bean, radish, corn, and tomato.



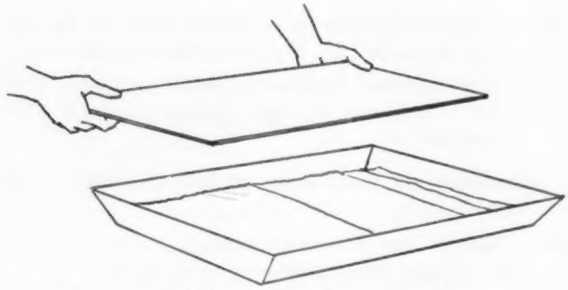
Have the young scientists proceed as follows. Spread a thickness of six or eight paper towels over the bottom of the cookie sheet. The exact number is unimportant except that enough towels are needed to hold moisture for several days.

Spread the seeds out on the towels in a regular spacing arrangement. If 100 seeds are used, percentages of germination may be computed more easily.

Cover the seeds with a similar number of paper towels. Moisten the paper towels all the way through, but do not allow excess water to remain in the trays. Press the towels down firmly. A board, a piece of glass, or another tray may be used to cover the germinator to prevent rapid loss of water by evaporation.

Place the tray on a shelf for several days at room temperature and examine the results from time to time.

Encourage different pupils to try variations of the experiment in order to test for the conditions necessary for germination.



A board, a piece of glass, or another tray may be used as a cover to prevent loss of water.

Some possible outcomes of this activity and the subsequent discussion may be listed as follows.

INFORMATION. Seeds need water to germinate. Seeds do not need sunlight to germinate. Seeds need heat to germinate (or, depending on grade level, seeds need a certain temperature of heat to germinate). Seeds contain food. Seeds produce young plants.

SKILLS. Skill in germinating seeds, setting up an experiment, observing results of an experiment, reasoning from observations, expressing ideas, and computing percentages.

ATTITUDES. Interest in growing plants, desire to do more experiments with plants, and appreciation of the use man makes of seeds.

These "coupon service" pages announce the availability of free and low-cost teaching aids for science. Those that are business-sponsored have been reviewed by the NSTA Evaluation Committee and approved for distribution by the Association. To procure copies of desired items, fill out the corresponding coupons and mail these, together with any remittance required, to the NSTA Executive Secretary, 1201 Sixteenth Street, N.W., Washington 6. Watch these columns for additional offerings in future issues of *The Science Teacher*. (Print or type coupons.)

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THE EDISON EFFECT—THE BEGINNING OF ELECTRONICS. *Thomas Alva Edison Foundation.* Second in a series of booklets describing Mr. Edison's principal inventions. The first, *The Incandescent Light,* was distributed in NSTA Packet XII. Authentic and very readable, beautifully illustrated. This booklet is informational for teachers and useful to students of junior high school age and older. Foreword by Charles F. Kettering. 72 pages; 50 cents.

Please send me .... free copies of **Romantic Copper.**

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LIVING WITH LIGHT. *Better Light Better Sight Bureau.* Folder, available without charge, describing "Living with Light," a program for instruction in light and sight in 7th, 8th and 9th grades. Includes 3 film strips, 6 study folders and teacher's guidebook. Presents practical information on relationship of light and sight, complexity of seeing process, and importance of comfortable seeing.

WHAT THE IDEAL CHEMISTRY COURSE SHOULD BE. *National Science Teachers Association.* Reprint of the popular article by Elbert C. Weaver which appeared in the November, 1951, issue of *The Science Teacher.* Provides numerous instructional suggestions. 20 cents a copy.

Please send me .... copies of **The Edison Effect at 50¢ each. (Remittance enclosed.)**

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OPPORTUNITIES IN ATOMIC ENERGY. *Vocational Guidance Manuals.* Informational book covering all aspects of atomic energy and providing a wealth of vocational guidance information. See review, *The Science Teacher,* October, 1951, page 218. $1.00.

SCIENCE TEACHERS' GUIDE FOR WOOD EXPERIMENTS. *Timber Engineering Company.* Instructions and study questions for 18 experiments with wood. Useful for group activities and for special projects. Suitable for general science, biology, chemistry, and physics. Prepared in consultation with NSTA. Fifty cents a copy. (*Wood Study Kits,* including wood samples, manual, and special magnifying lens, $8.50.)

SAFE USE OF ELECTRICAL EQUIPMENT. *National Education Association.* Booklet for teachers, laymen, and students. Provides information, teaching suggestions, and quiz. Produced cooperatively by NSTA and National Commission on Safety Education. Special price to NSTA members only, 25 cents (50 cents to non-members).

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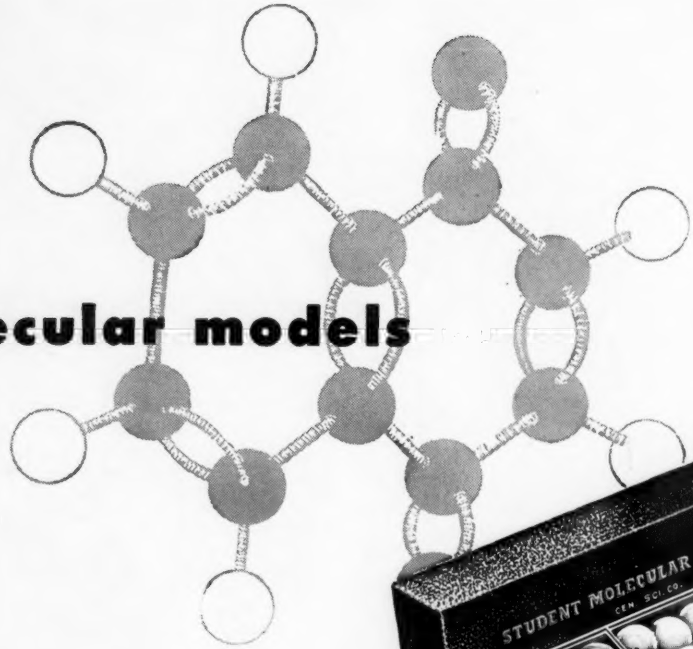
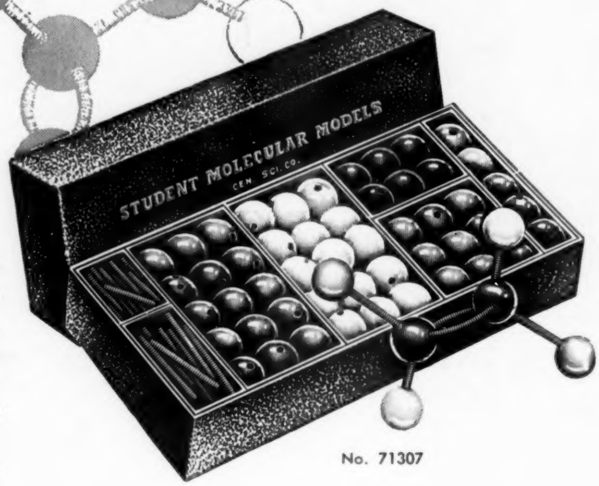
Our Advertisers

Chemistry on Farms Runs to Big Figures

A century of agricultural chemistry has had its greatest economic effect in rising use of mineral fertilizers, but recent new developments promise still greater efficiency in crop production, according to a USDA scientist. Speaking to the National Agricultural Chemicals Association, he cited figures to show how far into farm practice some of the new chemicals have worked their way, almost all in less than ten years and some in less than five. In 1950 farmers applied chemical weed killers to more than 30 million acres. Several hundred thousand acres of grassland have been freed economically of sagebrush by airplane application of 2,4-D. More than 10 million pounds of organic fungicides were used in the U. S. in 1950. Treating peanut seed with fungus-killing dust has boosted yields up to 25 per cent. Chemical thinning of apples in the Northwest has given a 15 per cent increase in yield at a fraction of the cost of hand work. That area chemically thinned 20,000 acres of apples at blossom time last year. Still under way are studies of means of controlling citrus decay.

Molecular models





No. 71307

The study of the structures of organic compounds has always been difficult to present to the student without the use of expensive models. The latest development for student study is a low-cost, compact set of models with which three-dimensional representations of molecules can be easily produced.

The set was developed according to the suggestions of Professor George F. Wright and other members of the department of chemistry of the University of Toronto. Colored wood balls represent atoms; ⅛″ diameter coil springs represent multiple and cyclic valence bonds. Four holes, drilled at angles of 119° 28′ in the black carbon balls, allow formation of the tetrahedron postulated by van't Hoff and LeBel; this arrangement permits showing diastereoisomerism and enantiomerism of substances such as lactic and tartaric acid.

Three lengths of springs include: 35 C-aliphatic bonds, 1½″; 35 C-hydrogen bonds, 1″ (both aliphatic and hydrogen bonds correspond to bond radii of C-C and C-H as outlined by Pauling in *Nature of the Chemical Bond*), and 15 C-aromatic bonds, 1⅛″ (for the formation of symmetrical benzenoid forms).

The colored balls, ¾″ in diameter, include: 30 Carbon (black); 30 Hydrogen (white); 12 Oxygen (red); 18 Halogens (green); 5 Nitrogen (orange); 5 Sulfur (yellow). The diameter of the holes permits use of cut household matches for rigid bonds in permanent models.

No. 71307 Molecular Model set is sold complete with instructions for $5.00.

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